Blockchain 2.0—The Impact of Smart Contracts on Intermediaries

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Abstract. Blockchain and smart contracts are modern technologies to improve digitalized and connected processes in companies. The blockchain technology describes a database of records or a public register. Smart contracts are characterized by the fact that they automatically and electronically execute the clauses of a contract and thus manage business transactions. The combination of both technologies enables process optimization and increases security. However, some professional groups, especially in the legal and tax sectors, consider these smart contracts as a threat to their role as intermediaries. The objective of this paper is therefore to investigate the impact that smart contracts have on companies as well as their stakeholders. The paper focuses on the role of the intermediaries and the potentials of this technology. This results in the following three use cases: the optimization of the signature run in a document management system, the automated licensing, and the development of a smart contract toolkit. The examples are illustrated by a software service company.

Keywords. blockchain · smart contracts · innovation management · smart contract applications · intermediaries

1. Introduction

The importance of digitization is presently steadily increasing. Companies must question their established business models. At the same time, they are forced to discover new possibilities to ensure their success in the long term. Digitization is therefore becoming a key factor. Accordingly, companies are also developing their existing processes to make them more efficient (Bleicher & Stanley, 2016). In this environment, blockchain is currently considered one of the most important technologies. The Gartner Hype Cycle confirms this by also considering it one of the top trends in 2018 (Panetta, 2018). Numerous companies are working on proofs of concept or feasibility studies (Bashir, 2018). Well-known universities and institutes such as the MIT Sloan School of Management, Harvard Business School, and the Fraunhofer Institute are also conducting research on the topic of blockchain (Michelman, 2017; Catalini, 2017; Iansiti & Lakhani, 2017; Schütte et al., 2017). This has led to many fields of application that make use of the blockchain principle. In sensitive sectors such as law and taxation, security plays a decisive role alongside process optimization. Together, these can be approached with the help of smart contracts. They allow the automation of processes, regulations, or even organizational principles by defining certain rules and activities when carrying out transactions on blockchain (Schütte et al., 2017).

Both companies and research have already taken up smart contracts and have created a basis for understanding this technology. On the part of the scientific community, the four topics of coding, security, privacy, and performance have been considered. However, they currently require further research (Alharby & van Moorsel, 2017). Due to the various applications of blockchain in companies, potential areas of application for smart contracts have emerged. This is shown by implemented or currently planned use cases, such as the use of digital identities or the use of smart contracts in the supply chain (Ream, Chu & Schatzky, 2016; Chamber of Digital Commerce, 2016).

Despite the wide range of possible applications, many questions remain unanswered with regard to their use. One current challenge is data protection. For this reason, smart contracts have been used only to a limited extent so far. One problem here is that in a public blockchain network, all information is accessible to every user (Spancken, Hellenkamp, Brown & Thiel, 2016). For this reason, a suitable platform must always be created to protect confidential data.

The elimination of intermediaries is also mentioned in this context, and these intermediaries can be found in the financial, administrative, and legal fields (Swan, 2015a). Consequently, the question arises as to how companies should deal with this development. Companies whose clients act as intermediaries are particularly in demand.

Some companies have already recognized the need for action and are working on new concepts. Specifically, the following questions arise that need to be examined and clarified: What are the new technologies of blockchain and smart contracts, and how exactly do they affect intermediaries or companies that work with them? What potential do the technologies have, and how are they already being used? Which new application scenarios can be implemented with the help of smart contracts to ensure the future security of the professional groups of intermediaries affected by the change? Which possible challenges, requirements, and benefits are derived from these scenarios for companies and their customers? This article will deal with these topics and offer possible solutions.

To answer the above questions, an overview of the theoretical foundations of blockchain and smart contracts is given at the beginning. This includes the definition and delimitation of relevant terms firstly and then discusses already implemented applications from practice. This is followed by an explanation of the methodology that was decisive for the conception of the application scenarios. Finally, three different proposals for the concrete implementation of intelligent contracts are developed in order to solve the problem related to intermediaries that has been pointed out. These scenarios will be illustrated using a software service company as an example. The following discussion addresses and classifies the possible challenges and benefits of the proposals. The concluding section takes up limitations and gives recommendations for further research needs. In addition, there are implications for the handling of the blockchain and smart contracts topics. This is accompanied by an outlook on future developments. The final section concludes the paper.

2. Theoretical foundations

2.1. Definition, function, and properties of blockchain

So far, no uniform definition of the term blockchain has been established. Basically, it is described as a distributed database of records or as a public, decentralized book. This comprises all transactions or digital events that have been carried out and distributes them to all parties involved (Alharby & van Moorsel, 2017). Each transaction is checked by the consensus of a majority of the network participants before it is included in the blockchain. Once information is entered, it is stored there permanently and in a verified manner (Crosby, Nachiappan, Pattanayak, Verma & Kalyanaraman, 2016). In general, the increasing public attention toward this technology can be traced back to a white paper by Satoshi Nakamoto published in 2008 and the crypto currency Bitcoin, which has been in existence since 2009. On this basis, it has since been possible to divide the development of blockchain into the following three phases: Blockchain 1.0 deals with the crypto currencies mentioned above, while Blockchain 2.0 deals primarily with smart contracts in the financial sector as a priority topic. Finally, Blockchain 3.0 describes the further development of smart contracts into decentralized autonomous organizational (DAO) units (Schütte et al., 2017).

In general, a transaction consists of a sender and receiver and is secured by an encryption key. Several transactions form a block, and several blocks lead to a blockchain (Frøystad & Holm, 2015). A blockchain network is formed by nodes, also called clients. A node serves as an entry point for the users of blockchain. Together, the nodes eventually form a peer-to-peer network. The users can access it by using private or public keys ("Private/Public Key"). The private key is required to sign one’s own transactions and to identify oneself. In the network, these transactions can in turn be accessed using the public keys (Christidis & Devetsikiotis, 2016). In fact, it serves as a public address. In concrete terms, a transaction is carried out in five steps in blockchain (Burelli et al., 2015; Frøystad & Holm, 2015): First, the sender generates a transaction and transmits it to the network. The transaction message contains details such as the public address of the recipient, the value of the transaction, and a cryptographic digital signature. This signature is used for authentication. In the next step, the nodes of the network, that is, the users or their computers, receive the message. Authentication takes place by decrypting the digital signature. Once this is done, the transaction is added to a collection of pending transactions. This is an updated version of the account ledger. The new ledger created in this way is called a block. In addition to the transactions recently confirmed as valid, the block contains a header—a reference code to the previous block. It also has a randomly selected sequence of numbers, called nonce. After a certain time interval, the block is sent to the network for validation. The validation represents the fourth step. The nodes that take on the role of the validator receive the proposed block. They validate it in an iterative process. The process requires the consensus of the majority of network users. Depending on the blockchain, different types of consensus-building processes can be distinguished. All agree to check the validity of the transaction and thus prevent fraudulent transactions. In the last step, the new block is finally attached to the blockchain. The node that first completed the upstream process communicates the latest status of the extended blockchain to all participants in the network. A prerequisite for this is that the transaction has previously been found to be valid (Burelli et al., 2015; Frøystad & Holm, 2015).

The creation of new blocks is also called mining. Consensus is used to select the block that will be added to the blockchain as the next element. If a cryptographic puzzle that must be solved to include a block is used, this is called a proof of work. Since this method is considered very costly due to some disadvantages, such as high investments in hardware and high energy consumption, there is an alternative in the form of the proof-of-stake procedure. Here, a consensus is reached as soon as a majority of the shareholders of a system receive the same result. Proof of stake is therefore suitable for use in a private blockchain. In addition, consensus can also be reached by designating a node as a miner (umpires), lottery-based selection, and other procedures (Schütte et al., 2017). Consensus building is necessary to maintain the functionality of the blockchain, which is required for smart contracts (Morabito, 2017). This is the only way to ensure that so-called forks are not created, which would endanger the continuity of the chronology of the network (Christidis & Devetsikiotis, 2016).

Now that the mode of operation is known, certain characteristics and potentials will be discussed here, being the factors increasing the interest in this technology, as Schütte et al. (2017) summarize. One characteristic is the distributed consensus building. Through this, blockchain technology can replace intermediaries in business processes who were previously involved as trusted third parties. Instead of an individual, the collective is now trusted. This has a lasting effect on existing business models but also enables new ones. Furthermore, the blockchain can be used to map both financial and real-world values. The access rights to these values can be transferred clearly and permanently among the users. The previous so-called Internet of Information is evolving into the

Internet of Value. The concept of smart contracts also allows the automation and decentralized execution of predefined processes on the blockchain. For this, predefined rules and execution instructions are required. Finally, the blockchain is characterized by traceability and irreversibility. The mapped transactions can be viewed by all users and are therefore traceable at any time. They can neither be manipulated nor deleted afterward, which guarantees the irreversibility of the data. This opens up new possibilities in the areas of compliance, auditing, and the review of processes (Schütte et al., 2017).

2.2. Definition, function and properties of smart contracts

Traditionally, a contract is described as a legal transaction consisting of at least two freely concurring declarations of intent (Morabito, 2017; Norta, 2017). The problem with contracts is that they only work if there is a mutual trust between the partners and if they are sufficiently specified (Norta, 2017). In this situation, however, there is a high potential for conflict as the parties to the contract often pursue different interests and goals. To counteract this, independent parties are often involved. These act as trustworthy third parties in the form of a mediator and support the fair drafting of the contract (Fröwis & Böhme, 2017). Figure 1 illustrates this principle.

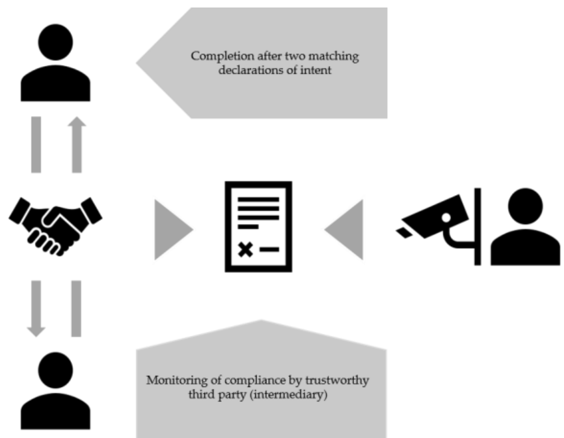

Figure 1. Trust problem of a contract.

One possible solution to the aforementioned trust problem is the smart contract. This regulates business transactions between the contracting parties automatically and electronically (Norta, 2017). This requires rules and execution instructions that enable contracts to be executed without the need for an intermediary (Bailis, Narayanan, Miller & Han, 2017). The idea of the smart contract was first conceived in 1994 by Nick Szabo (Christidis & Devetsikiotis, 2016; Szabo, 1994). However, at that time, the necessary technology to support programmable business transactions between partners was not yet available. Consequently, his original idea was only recently realized. The development of Bitcoin led to the distributed ledger technology, that is, the technology of decentralized registers, which enables the smart contract (Al Khalil, Butler, O'Brien & Ceci, 2017).

Szabo (1996) describes smart contracts as a computer-based program capable of executing the clauses of a contract. He understands them as a set of promises made by all parties involved, delivered in digital form (Szabo, 1996). The promises that Szabo (1996) means by this can be both contractual and non-contractual and can consist of contractual terms or rule-based operations. The smart contract is executed electronically, and the contract clauses or results are embedded as code in the software. A protocol in the form of an algorithm establishes a set of rules that determine how the data of the individual parties are processed. Furthermore, they enable the execution of actions. Smart contracts are mapped on a blockchain network, stored, and thus executed automatically. Therefore, once started, they are irrevocable and cannot be stopped (Chamber of Digital Commerce, 2016).

A concrete example of the use of smart contracts can be demonstrated by means of an inheritance gift that becomes available either on the 18th birthday of the grandchild or on the anniversary of the grandparents' death. The transaction is created on the blockchain and remains inactive until a certain time or event activates the smart contract. The first condition is that the grandchild receives his or her inheritance on his or her 18th birthday. To program the second condition, a so-called oracle scans information, for example, from a death register database, to confirm that the grandparents have died. As soon as the smart contract records the deaths, it automatically releases the money for the grandchild (Swan, 2015a). The advantage is that the money is forwarded to the grandchild without delay. A normally required consultation with a notary is not necessary. The procedure is also more cost-effective due to the elimination of the classic trusted authorities.

The life cycle of a smart contract is divided into four phases. After two or more parties have expressed their willingness to enter into a contract, the first phase begins with the drafting of the smart contract. It consists of the contract negotiation, which can also be done iteratively, and the implementation phase. First, the parties negotiate the terms of the contract and agree on the content and objectives of their business. This step is similar to the traditional contract and can take place either offline or online (Sillaber & Waltl, 2017). In addition, all participants need a public and private key. The public key serves as a public address. With the help of the private key, the owner can identify himself. This is required for all transactions (Chamber of Digital Commerce, 2016). As soon as the conditions of the agreement are defined, the agreement is translated into program code. Finally, the code is inserted into the distributed ledger, and the nodes receive the agreement as part of the transaction block (Sillaber & Waltl, 2017). In the second phase, all transfers of the smart contract are frozen until the nodes have validated the entire transaction after the contract has been executed. Only then do money recipients, for example, have access to transferred money. In the case of a public blockchain, the transaction fees are also paid to the miners for their validation computing services in this phase. The smart contract and all participants are published in the ledger (Sillaber & Waltl, 2017). The third phase then executes the smart contract. Here, contracts stored on the distributed ledger are read by the participating computer nodes. The nodes check whether all prerequisites for executing the contract are fulfilled. The integrity of the smart contract is validated, and the compiler of the smart contract's environment executes the code. The results and new status information are forwarded to the distributed ledger and confirmed by consensus protocol (Sillaber & Waltl, 2017). Now, in phase four, the smart contracts are concluded. Once the process is validated by the consensus protocol and sent to the blockchain, it can no longer be changed. The digital assets previously entrusted to the blockchain are then transferred to the business partners. With the confirmation of all transactions, the smart contract is fulfilled (Ream et al., 2016; Sillaber & Waltl, 2017). After execution, all computer nodes in the network update their ledgers to store the new, updated version of the blockchain (Sillaber & Waltl, 2017).

The following four important properties can therefore be derived from this mode of operation: transparency, autonomy, decentralization, and elimination of the intermediary. Transparency results from the fact that the blockchain and thus also the smart contract code can be viewed at any time. Since the blockchain is designed similar to a public register, all participants have access at all times. This creates trust in the proper handling of the process (Meitinger, 2017). The smart contract is also described as autonomous since the code does not require any additional commands after its original activation and is executed completely automatically. The contract itself does not need to be in further contact with the trigger. As soon as several smart contracts are combined, they are either mutually dependent or mutually exclusive (Swan, 2015a). Furthermore, smart contracts have the characteristic of being decentralized. They do not only exist on a central server but are distributed and executed across many network nodes (Swan, 2015a). This means that the participants in a blockchain can trust that a smart contract will continue to be executed in the event of a server failure, for example. In addition, the program code cannot be manipulated since this would require each individual block in the blockchain to be changed (Szabo, 1997). All these features mean that an intermediary, which serves as a control unit and monitors the proper execution of the smart contract, is no longer necessary. The smart contract monitors independently according to the if-then principle as to whether all prerequisites ("if") are fulfilled and executes the consequences ("then") without delay. The execution cannot be manipulated and cannot be executed incorrectly, provided that the code was generated without errors (Christidis & Devetsikiotis, 2016). A relationship of trust becomes superfluous, and the role of the intermediary is eliminated since validation is no longer performed by an individual but by the collective (Swan, 2015a).

2.3. Oracles as a bridge between blockchain and the outside world

A characteristic of blockchain technology is that it can only directly access data stored within the blockchain. It only supports the integration of deterministic data. Deterministic data occur when two independent calls to the same external application programming interface (API) receive the same result. Internet page data are not deterministic data. Determinism is important for the consensus that the nodes in the blockchain must reach in order to validate operations (Buck, 2017; Schiller, 2018).

However, for some operations, such as if-then checks in a smart contract, it may be necessary to access information outside the blockchain. This interface is served by oracles. They can be called from the blockchain and pass all necessary data, such as data from a website, to it. Oracles thus serve to connect smart contracts and the blockchain with the outside world (Carminati, Rondanini & Ferrari, 2018).

There are different types of oracles. On one hand, oracles bring data from the outside world into the blockchain, such as the current exchange rate between the dollar and the euro. This is relevant if a contract should only be executed under certain conditions. On the other hand, oracles give the smart contracts the possibility to send data to the outside world, like a smart lock. This is a smart lock for, for example, a house or car door. It can be programmed as desired so that it is unlocked by a smart contract when a certain condition is met, such as the receipt of a payment (Carminati et al., 2018).

The importance of oracles will continue to increase due to the growing number of use cases of smart contracts as they enable many new fields of application in the first place. Standard tools and interfaces that facilitate and support integration will become most important in this context (Buck, 2017; Swan, 2015b).

2.4. Fields of application of smart contracts in the economy and public sector

A large and central application area for smart contracts is the financial sector. Payment and settlement processes can be handled faster, more cost-effectively, and also error-free thanks to the new technology (Chamber of Digital Commerce, 2016; Schatzky, 2016).

In addition, international credit transfers benefit above all from the reduction of high fees and the minimization of exchange rate risk while non-invoiced transactions, so-called smart payments, can be decoupled from the actual billing process and automated (Schütte et al., 2017).

There is also potential for the healthcare sector in the form of various solutions. Sensitive patient data, for example, are often distributed across different and independent systems. Smart contracts can help patients to gain better control over the use of their personal data (Schatzky, 2016; Schütte et al., 2017).

Smart contracts also make it easier for media and technology-oriented companies to manage and grant media rights that are difficult to monitor. The introduction of digital rights management, that is, the administration of digital rights, automatically transfers royalties to the author. In the cases of song, image, and video rights on the Internet or the granting of software licenses, there is no need for intermediaries or brokers (Müller, 2017; Schütte et al., 2017).

In the industrial sector, especially in supply chain management, the involvement of many players can make the handling of financial processes more difficult and result in a large administrative burden. Smart contracts manage approvals and initiate payments automatically, which increases reliability. Barclays Corporate Bank, for example, recently teamed up with Start-Up Waves, a platform that uses smart contracts to log changes of ownership and automatically transfer payments (Ream et al., 2016).

An example of an application in the energy industry is the automatic payment process during recharging. The smart contracts are configured in such a way that vehicles are charged with electricity from renewable energies as soon as a sufficient amount of it is available. Smart contracts thus guarantee the remuneration of producers (Neumann, Demidova & Kohlhoff, 2017).

In addition to their use in the private sector, such electronic payments (e-payments) will be easy to implement in the future. They will be used for tuition and administration fees and enable authorities to work more effectively. The Swiss city of Zug, for example, already accepts Bitcoin as a means of payment, thus reducing the exchange rate risk for the administration (Chamber of Digital Commerce, 2016; Schütte et al., 2017).

2.5. Advantages and disadvantages of smart contracts

Smart contracts offer certain advantages and disadvantages due to their specific characteristics. As mentioned, the most important advantages are transparency, autonomy, and decentralization (Meitinger, 2017). Other advantages of smart contracts include the increased speed of contract execution. Since no office hours are spent waiting for reactions, but a program is always working, the processes are executed at maximum speed. Audit-proof archiving is also a benefit of smart contracts. Data once stored on the blockchain cannot be removed. Likewise, the necessary identification of all processors on the blockchain using a private key ensures security integrity for all transactions. The technology also offers the advantage that, unlike people, it always works impartially. This opens up potential for more objective results, such as in automated auditing. In this case, an audit at a company is carried out automatically and thus without the need for a notary. This avoids conflicts of interest for auditors (Andersen, 2016; Groß & Wagner 2018).

In addition, there are also some disadvantages with smart contracts. The main disadvantage, which also guarantees the high security of the blockchain, is the immutability of the blocks. In case of an error in the code, it executes the commands exactly as they were previously defined. The execution of the code must be completed before changes can be added. In addition, smart contracts cannot be invalidated like a conventional contract because they execute themselves, regardless of whether or not they are valid. This is one of the reasons why the code must be formulated precisely. Errors have negative consequences, such as the possibility of not being able to ward off hacker attacks (Sklaroff, 2017).

Data protection is an important issue in connection with blockchain technology and smart contracts. In a blockchain network, all information is publicly accessible to every user. The underlying technology of the public blockchain therefore excludes privacy, which is critical for confidential data (Spancken et al., 2016). A possible solution is offered by so-called private blockchains. The main difference to public ledgers is that participation requires an invitation or permission. The owner of the blockchain can impose rules and thus restrict participation in the network and transactions (Jayachandran, 2017).

Not every smart contract automatically represents an actual contract. For this to be the case, two concurring declarations of intent are still required (Hulicki, 2017). The exact attribution of the declaration of intent to a person can prove to be a difficulty as direct interaction is shifted to the digital world. At this point, electronic legal entities, or e-identities, are discussed as a possible solution (Vereinigung der bayerischen Wirtschaft, 2017). Here, the state must ensure legal certainty and create a framework for the use of blockchain technologies and smart contracts.

2.6. Prerequisite for the application of smart contracts in a software service company

An essential cornerstone of the function of a public blockchain is that the data on the blockchain be accessible to all network participants since every transaction must be validated by a majority of users (Morabito, 2017). To comply with the privacy policy of a software service company, a suitable framework must first be created in which these transactions can be processed in a secure form.

The development of a complete corporate blockchain platform is one way to meet all the necessary privacy requirements. However, there are also some challenges, such as tying up manpower. It may be necessary to purchase the necessary knowledge in the form of blockchain experts or university graduates with the appropriate know-how on blockchain technology. These specialists are among the most sought-after and therefore expensive workers (Oh & Wallsten, 2018). The development of one's own blockchain is therefore cost and time intensive. A further option for the software service company are development cooperations with other companies or start-ups.

In addition to the idea of one's own development, an analysis of the already existing blockchain platforms as well as their potential for the respective application ideas should be carried out. So far, several platforms for the creation of smart contracts have already been developed. One of the best known and most widespread platforms is Ethereum (Ethereum Foundation, 2018). Ethereum is a so-called public blockchain. However, it is also possible to create private blockchains, which form side chains to the main public blockchain (Afanasev, Krylova, Shorokhov, Fedosov & Sidorenko, 2018).

Furthermore, Hyperledger's smart contracts platform, Hyperledger Fabric, could be used. Several companies are jointly developing the Hyperledger blockchain platform to meet the needs of the business world. Fabric is a so-called permissioned platform. This means that all participants are known (Florea, 2018). In Hyperledger Fabric, so-called channels can be set up. A channel is a private subnetwork for communication between two or more network participants in which private and confidential transactions are possible. To operate in a channel, each participant must be authenticated and authorized (Benhamouda, Halevi & Halevi, 2018). This means that the network can be used by many parties and, depending on their needs, can be divided into channels for specific topics. Data confidentiality and privacy are ensured (Cocco & Singh, 2018).

In addition, many other blockchain platforms are currently in the development and growth phase, such as EOS or IOTA (Block.one, 2019.; IOTA Foundation, 2018). The latter is interesting because its Qubic platform, released in June 2018, offers a way to create oracles directly on the platform and thus provides a versatile tool for the creation of smart contracts (IOTA Foundation, 2019). It is therefore important to closely monitor and analyze the further development and expansion of the functional scope of these platforms. Based on this, the following section will derive application scenarios, especially with regard to the software service provider.

3. Methodology

The starting point was a joint workshop between the team of authors and practice partners. First, the software service company was presented, and the current business areas were explained. This was followed by an introduction to the topic of blockchain in general and how the practice partner has dealt with it so far. In this way, the problem was conveyed.

This was followed by a first stage of research to get to know the introductory literature on blockchain and smart contracts. At the same time, there was coordination within the group of authors to determine the further procedure. After this method had created a basic understanding for the relevant aspects of the topic, a detailed analysis of scientific as well as practical literature followed in order to obtain specific information for the solution to the problem. Special attention was paid to the topic of smart contracts as well as blockchain as a basis for defining and delimiting terms. Likewise, an understanding of the functionality, possible applications, and advantages and disadvantages was to be created. For this purpose, literature from both science and practice was used. It turned out that the intelligent contracts take over the role of the previous intermediaries and thus make them obsolete. Since the software service company has to a large extent taken over the role of the intermediaries, there may be revolutionary consequences for the company. The relevance of the topic became apparent, and the problem was articulated accordingly.

Subsequently, the results obtained were summarized, structured, and clearly presented to serve as a basis for the development of concrete use cases. In the next step, the software service company selected for the use of smart contracts was examined, which serves as an example in this paper. The analysis focused in particular on its existing product and service portfolio and its current business areas. In addition, the customer groups and business partners served were included in the review.

The findings of the research on the technologies blockchain and smart contracts were finally conferred over in a focus group discussion, in accordance with Morgan (1997). In parallel, the brainstorming method was used to develop possible applications (Clark, 1989; Schawel & Billing, 2012). This allowed ideas and suggestions to be garnered on how to use the smart contracts in accordance with the needs of the software service provider. A longlist was created. The results of the focus group discussion and brainstorming were then structured and evaluated in terms of their feasibility. The longlist was reduced to a shortlist. From this list, those concepts were selected that were most relevant for the software service company.

Subsequently, the application scenarios were elaborated in a first phase. The focus here was on the functionality and the technical requirements for this. Once these were available, an expert discussion with the employees of the software service company followed. They conducted intensive research for the company on the topic of blockchain and application fields. The experts were presented with the current status of the proposals for the use of smart contracts. They were also asked about special features of the company. Based on the findings of the literature research, brainstorming, and focus group and expert discussions, the following three application scenarios were developed. The application proposals were refined and then finalized. The concrete results are presented and explained in more detail below.

4. Applications of smart contracts in the software service company

Based on the research on blockchain and smart contracts and the presented methodology, three application scenarios for the intelligent contracts at the software service company could be developed in the end. The applications set different priorities. As a separate platform can be flexibly designed, the applications focus primarily on existing platforms. The proposals are explained on the basis of concrete use cases to better illustrate the effects on the company or the customers from the intermediary sector. The following three scenarios and their functions are explained in detail in this section:

Scenario 1: Processing the signature run in the document management system
Scenario 2: Software licensing
Scenario 3: Smart contract toolkit and consulting

4.1. Processing the signature run in the document management system

An application based on an existing product of the software service company and smart contracts is the trustworthy and automated processing of signature runs. For this purpose, the software service provider's document management system is being expanded. The idea is to use a smart contract to speed up the process of obtaining all required signatures for a document and to simplify workflows. This is particularly useful for documents that require the signatures of many parties.

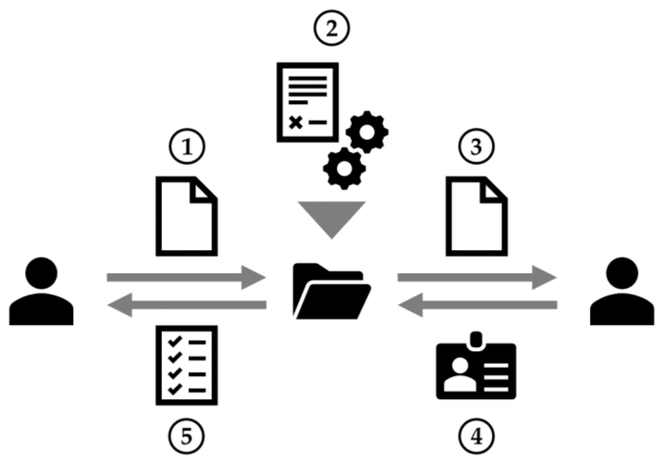

Figure 2. Processing the signature run by smart contracts.

Figure 2 shows the process flow. For reasons of comprehensibility, only one signing party is used. Of course, in reality there may be a significantly larger number of signatories. The following example illustrates the scenario:

A customer who is an auditor and thus a user of the software of the software service company requires a signature from the managing director of a company that is audited by him. The following steps are therefore necessary to obtain the signed document:

Step 1
The auditor files the document to be signed in the document management system. The document is not stored in the blockchain but on a secure server, such as the company's own computer center.
Step 2
The smart contract accesses the document and stores a reference to it in the blockchain.
Step 3
The smart contract uses an oracle and thus notifies the company's CEO that a document is available for him to sign.
Step 4

The manager can sign the document with his digital identity stored in the blockchain. The existence of a digital identity is assumed here. In this case, the digital identity can be the managing director's employee card. However, a role authorization must also be stored here, which authorizes the signature of the document in question. If the document is not signed in the previously defined time, reminders are sent automatically.

Step 5

The smart contract recognizes as soon as all signatures are available. In this example, the signature of the managing director is sufficient. The smart contract now informs the auditor about this and, if necessary, files the document accordingly. The workflow of the smart contract is now regarded as completed.

4.2. *Software licensing*

A relatively quick implementation of smart contracts is possible with automated software licensing, where the smart contract takes over contract conclusion, verification of receipt of money, and delivery of the software after initiation by the customer.

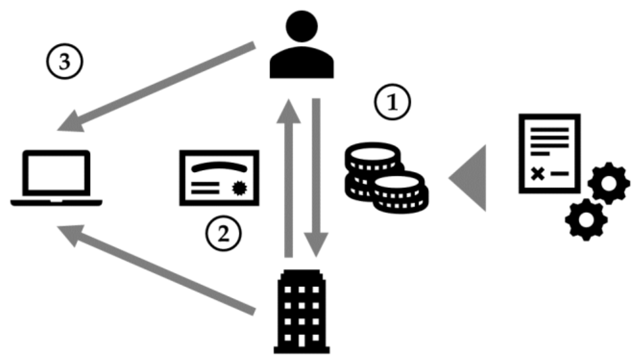

Figure 3. Software licensing by smart contracts.

Figure 3 illustrates the sequence of the scenario. An auditor wants to purchase a software license from the software service company for two years. The smart contract carries this out without delay. The following list of steps details the procedure:

Step 1

The auditor orders the software license on the website of the software service company. The order activates a smart contract, which monitors the receipt of money.

Step 2

As soon as the auditor has paid the license fee and the smart contract notes the money as received, the latter automatically sends the license key and activation link to the auditor.

Step 3

The auditor can download the software license and then use it directly.

4.3. *Smart contract toolkit and consulting*

As the software service company already has extensive expertise in the IT sector and is itself conducting research in the field of smart contracts, it can pass on its previously acquired knowledge and experience to its customers. For this purpose, the software service company is developing a toolkit that enables the creation and execution of smart contracts within a pre-defined framework. The toolkit itself is free of charge, as is the creation of the smart contract. The only costs incurred by the customer are those for execution. For the subsequent financing, either pay-per-use or a flat rate is agreed upon, depending on frequency of use.

In addition, the software service company offers various consulting services on the subject of smart contracts and the associated toolkit. It provides its customers with the necessary expertise to use the toolkit independently and to create their own smart contracts. This can be done through basic training, topic-specific workshops, or, in individual cases, specific consulting.

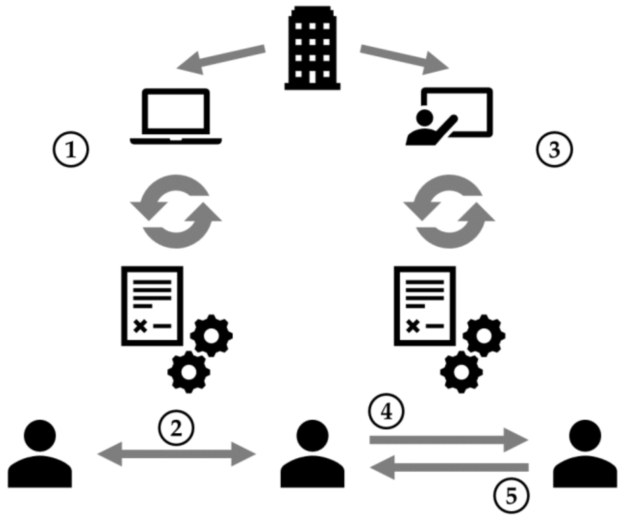

Figure 4. The software service company as a provider of smart contract toolkit and consulting.

Figure 4 shows the two pillars of this application scenario, the use of the smart contract toolkit and consulting. This is illustrated with the following example:

Step 1
The software service company provides a toolkit with which its customers can create smart contracts from ready-made building blocks.

Step 2
A lawyer and customer of the software service company is asked by his client for help in drawing up a contract. The client wants to rent out his newly renovated holiday apartment. However, he does not know how to draw up the contract and therefore needs the expertise of his lawyer. The lawyer has recently been provided with the software service company's smart contract toolkit and has already been trained to use it. He now realizes that it is possible to automate the process of renting out by means of a smart contract. This is possible by combining a smart contract and a smart lock installed in the front door of the holiday home. A smart lock is an electronic door lock that can be controlled with a smart phone, for example. The classic key thus becomes obsolete. As soon as the money for the overnight stay has been credited to the client's account, the smart lock is activated for the rented time for the holidaymaker. This saves the client both the monitoring of the receipt of money and time as he no longer needs to be on site to hand over the key.

Step 3
The client approaches his tax consultant to clarify how he should declare the rental of the holiday home in his tax return. The tax consultant recognizes that the rental was processed using a smart contract and that therefore the data are already available in the blockchain. He knows that it is possible to link a new smart contract with the existing one. This new smart contract would automatically and quickly convert the already stored data of the rental into a corresponding form for the tax return.

Step 4
Since the tax consultant is not quite sure how to set up this special smart contract, he approaches the software service company and takes advantage of a consulting service. The software service company supports him in this and shows him how he can write a suitable smart contract using the toolkit.

Step 5
The tax consultant informs his client of the solution and executes the smart contract for him. He thus receives all tax-relevant data on the rental of the holiday home quickly and easily.

5. Discussion

The three application scenarios presented show how a possible application of intelligent contracts can be implemented in a company. This concept offers various advantages for the company—in the described case the software service company—as well as its customers, the intermediaries. At the same time, however, the implementation can be difficult because certain conditions must be met. Other challenges may also make the concrete implementation of the three proposals for the use of smart contracts more difficult. These aspects are discussed below.

The scenario for processing the signature run in the document management system shown first shows how the software service company can expand its established product to include additional functions. The improvement of the program enables the acquisition of new customers. At the same time, existing customers will be more loyal to the company by making the product more attractive. Since the blockchain only references the data but does not store them, its size remains manageable. The security of the data is also guaranteed in this way. The processing of the transaction is therefore clearly separated from the storage. For the customers of the company, the focus is primarily on functionality and less on the underlying technology. Therefore, they benefit from the significant reduction in administrative work through the automatic processing. The integration of a due date and reminder system also increases the rate of signatures received in a timely manner. The smart contract constantly monitors or tracks the process and is independent of office hours. In addition, the document management system supports users by giving different parties access to the latest version of the document at any time. Thanks to the smart contracts, they receive real-time information about changes. Transparency is improved, especially in cases where multiple signatures are required. The unambiguous identification of the persons signing the document by means of digital identity also creates increased security against manipulation. Thus, the authenticity of a document is always clarified by these authentication mechanisms. The real-time notification after the receipt of all signatures speeds up work processes. Overall, the new process results in greater efficiency and effectiveness throughout the entire process.

For the implementation of this first scenario, certain requirements must be met. Basically, the document management system must be compatible with the blockchain technology. However, if this is the case, it must also be clarified which blockchain platform is to be used. Users also need digital identities to be able to use the program at all. This can present great challenges. In the above example, the problem of identity management can be solved with the help of employee ID cards on which role authorizations are stored. This approach is relatively easy to implement since such badges are usually standard in many companies. In addition, they often already work with encryption systems, such as public key infrastructures. However, if a signature is required from a party outside the organization, for example a lawyer's client, an alternative solution must be pursued as the client is a private individual. In this case, an electronic identity card may be used. The corresponding user must have enabled the function. Only under this condition, is this alternative conceivable. However, it is problematic that, as things stand today, use in Germany is voluntary (Federal Ministry of the Interior, 2017). Consequently, it cannot be assumed that every user has this digital identity or uses it specifically. Targeted information on the advantages of the functions of digital identities will help to ensure that this option is used more widely.

With regard to licensing by means of smart contracts, advantages can also be realized for the software service company and its customers. For the company, use of this technology means that there are no time delays. The license is made available to the customer in real time. This way, the allocation is trustworthy. As a consequence, the risk of unpaid debts is reduced as the receipt of payment is a prerequisite for the activation of the ordered software. In addition, transaction costs are low: the intelligent contracts automate the process. The only costs incurred are for calling up an oracle. In addition, the blockchain stores every transaction in an audit-proof manner, thus the software service company benefits.

Licensing requires that the information about the receipt of payment be checked before the license key is issued. If the payment is made in crypto currency, this information is easy to transmit as both are available in the blockchain. However, the platform used must support this. The process is made more difficult when the payment is made by bank transfer, for example. In this case, the information must be forwarded to the blockchain from outside. The software service company must therefore implement an oracle that monitors this process and confirms receipt of payment. The integration of the oracle depends on the platform the company uses. For private blockchains based on the Ethereum platform, specialized providers such as Oraclize have developed suitable interfaces (Oraclize Limited, 2018a). Accordingly, once adapted to the needs of the company, the function would be relatively easy to implement. However, for most oracle vendors, each call of the function results in costs for the use of the services, as is the case with Oraclize. The so-called "call fee" varies depending on the complexity of the oracle used (Oraclize Limited, 2018b). If Ethereum is competent in the programming language "Solidity," the company can also write its own oracle. Hyperledger Fabric, on the other hand, uses common programming languages such as Go, Java, and Node.js, which many users have mastered for its smart contract code, the "chain code" (Florea, 2018). In addition, the execution of almost any program is possible. This simplifies the development and implementation of one's own oracles. In addition, pilot banking projects are already being conducted to create use cases for the integration of blockchain and smart contracts (Swan, 2015a; Wang et al., 2018).

The third application scenario, the creation of a smart contract toolkit with associated consulting services, represents a comprehensive expansion of the existing product and service portfolio. The software service company and its customers can derive far-reaching benefits from this. With this step, the company itself secures its own and its customers' future viability. In addition to the toolkit as a new product, the company offers a new service in the form of consulting. This increases customer loyalty since the program and consulting are offered from one source. As a result, the software service company is expanding its core competencies and positioning itself more broadly. It is thus creating new sales potential. The company is also responding to technological change by adapting its portfolio to current and future trends. In the case of cooperation with start-ups in the implementation of this scenario, the company receives further new impetus and benefits from external knowledge. The software service provider's customers benefit from the new offering as it enables them to develop a completely new business model with relatively low initial investment. This helps them especially in view of the threat to their role as intermediaries posed by digitization. The smart contract toolkit gives customers access to a new and innovative technology. Its use opens up opportunities for client retention and acquisition, for example, and thus new sources of income. If customers use the toolkit, the smart contract relieves them of the burden by automatically processing and monitoring the terms of the contract. In this way, the program significantly increases the efficiency and effectiveness of previously manual processes.

In addition to the decision on the concrete blockchain platform, acceptance among the participants is also an important prerequisite for implementing the toolkit. In addition, the high investments represent a potential challenge for the software service company. The company must gain access to the necessary know-how for the development of the toolkit. There are several possibilities for this; two will be examined in more detail. On one hand, the company can push the development in-house. However, this ties up human and technical resources over a long period of time and results in high investments. As an alternative, a cooperation with a start-up company can be entered into. A specialized partner from the field of blockchain and smart contracts has extensive expertise. For example, Unibright IT UG, founded in 2017, has experience in transferring business processes to the blockchain (Unibright IT UG, 2018). Start-ups are usually particularly convincing due to their novel and innovative knowledge, which makes them superior to established companies. However, they need investors and partners to be able to assert themselves in the market. Young companies also often lack the necessary network for growth, especially at the beginning (Preiß, Schildhauer & Wrobel, 2017). Accordingly, both sides, start-up and established companies, can benefit from each other.

The discussion shows that the solution approaches shown promise a variety of different benefits for the software service company itself as well as its customers. Especially the toolkit scenario has a lasting significance under the impression of the effects of smart contracts on intermediaries. Nevertheless, the implementation requires a multitude of different aspects to be fulfilled in advance. The challenges outlined above make it clear that the implementation of blockchain technology requires a high level of attention and a well-considered approach on the part of the company. Only on this basis can the implementation be a success.

6. Conclusion

This paper considers many aspects of smart contracts and takes them up in the course of the article. The questions asked at the beginning of the article on the topics of blockchain and smart contracts are answered. Thus, it is clarified what is meant by both technologies and what effects smart contracts in particular have. The question of what this means for intermediaries and what possible solutions for the application of smart contracts result from it have also been addressed. The discussion then went on to discuss what potential exists for companies and customers. Possible challenges and prerequisites are also addressed.

Nevertheless, the statements and recommendations made are limited in their validity. On one hand, the work is limited in its perspective on the software service company. Thus, it assumes that a company has a comparable structure with regard to organization and customers when implementing the presented applications of the blockchain. The company concerned must also be aware of the relevance of smart contracts for the role of the intermediary. On the other hand, only three elaborated solution approaches are in the focus of the work. Further scenarios are conceivable but could not be further elaborated within this limited framework.

Furthermore, the proposals focus on the underlying functional principle and the effects on the actors in the environment of the software service provider. However, the actual implementation and the steps necessary for this, especially from the technical side such as programming, were not examined in detail. The focus is thus on the economic aspects as well as implications for management. Furthermore, the applicability of the results is limited to the presented blockchain platforms only. Other platforms therefore require possible adjustments in the exact design of the scenarios.

Consequently, the paper illustrates the relevance of smart contracts for intermediaries. It shows the developed solution options for dealing with the effects from the point of view of the software service provider and its customers. However, the subsequent limitations make it clear that blockchain and smart contracts are far-reaching and complex issues. Consequently, there are still questions for which no or only insufficiently satisfactory answers have been found so far. Therefore, for further scientific work it is recommended to investigate some additional points. With regard to smart contracts, for example, the question arises as to how scalability is designed depending on the platform and how to deal with the existing restrictions. The cornerstone for this can be the standardization and certification of the blockchain, which is currently already being driven forward (Schütte et al., 2017). In addition, a clear way to create and integrate oracles must be found. This is where a study can start, which also aims to develop a uniform standard. In conjunction with this, it should be investigated how the flexibility of the blockchain can be increased in the future by applying certain basic principles for different cases. Intelligent contracts can benefit from this, especially in the long term.

Security and the protection of sensitive data or privacy are also relevant issues, especially for sectors such as tax and legal advice. These have already emerged as some of the current central problem areas (Alharby & van Moorsel, 2017). It is therefore important to analyze the impact of the use of smart contracts on neuralgic data.

The paper creates a fundamental sensitivity for the potential impact of smart contracts on the role of the intermediary. Nevertheless, it remains open as to what significance this technological advance actually has for trusted third parties. In this context, not only the economic perspective but also the legal and social science perspectives are of interest. This is followed by the question of the acceptance of such technologies by the professional groups concerned. If there is a lack of openness toward the solutions presented, their usefulness is reduced.

The proposals under consideration focus exclusively on the blockchain technology. However, especially in recent years, many other technologies have developed that now shape the digital age. For this reason, the networking of smart contracts with other technologies is interesting, making an isolated consideration in principle insufficient. Consequently, it should be examined whether and to what extent current trends such as artificial intelligence or robotic process automation can be combined with this technology. Under certain circumstances, this may result in further potentials that have not yet been taken into account and that are also relevant for companies.

In the specific case of the application examples shown, their concrete realization must also be examined. Especially the exact quantification of the required effort as well as the expected potentials should be determined in order to initiate the implementation. An investigation of additional companies of different types and sizes can help to uncover further areas of the application of smart contracts and thus generate new potential.

The blockchain technology and smart contracts already have far-reaching effects on almost all areas of the economy. These can be of both a negative and positive nature. Nevertheless, the new technology should be approached openly, especially on the part of the companies and professional groups that are strongly affected by this development. In conclusion, it should be noted that in particular, the change in the role of the intermediary triggered by smart contracts does not necessarily pose a risk. Rather, this change should be seen as an opportunity to reinvent or further develop oneself and one's own occupational profile. In this process, companies such as a software service provider will play a key role by supporting its customers as a partner with the shown application possibilities of intelligent contracts. Especially the development of one's own smart contract toolkit opens up the possibility to build up comprehensive know-how and competences in this field in the long run. In this way, competitive advantages can be secured. The two other proposals act as trailblazers in this respect so that knowledge is gradually increased. In this way, intermediaries and their partners will actively benefit from this change in the future.

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