A Use Case Identification Framework and Use Case Canvas for identifying and exploring relevant Blockchain opportunities

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ABSTRACT
Blockchain is a new, foundational technology with a vast amount of application possibilities. However, practitioners might not be aware of which use cases in their own business model might benefit from blockchain technology. To aid them in analyzing their business regarding blockchain suitability, this paper introduces a use case identification framework for blockchain and a use case canvas. In the development process they have been evaluated with internal and external reviews in order to offer the best possible guidance. In combination they offer an analysis framework to help practitioners decide which use cases they should take into account for blockchain technology, which characteristics these blockchain implementations would have, and which specific advantages they would offer.

Author Keywords
Blockchain; Identification Framework; Use Case Canvas

MOTIVATION

About blockchain

Contracts, transactions and related data sets are concepts which are indispensable for everyday life. Ownership of assets or agreements between several parties need to be documented and made transparent. The digital transformation enables new opportunities to realize these documentations, but also poses new challenges which need to be acknowledged. Blockchain is a foundational technology which can hold up to these challenges, enabling data security and transparency while documenting transactions in a decentralized, secure, transparent and irreversible way [4].

Blockchain is defined by a few unique characteristics: Firstly, the technology uses distributed consensus-building between the nodes in the blockchain network instead of having an intermediary approving all transactions [9]. Rather than having to trust this third-party intermediary, trust is placed in the technology itself. Additionally, transactions can be processed almost immediately, instead of having to wait for the third party to process them [13]. Secondly, the blockchain enables the transfer of rights to real-world objects and values explicitly and permanently, making the verifiability of ownership and rights straightforward [9]. Thirdly, all transactions which are stored in the blockchain are irreversible and transparent, therefore the data cannot be tampered with.

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We define blockchain as a technology which can offer increased value for partners cooperating in a decentral network by providing data and process integrity, automation potential and enabling the transparent transfer of values and rights.

Using a blockchain to document transactions has the advantage of having a digital record and a digital signature for every transfer of rights to objects or values, but also for agreements, processes and tasks [4]. Using blockchain for agreements or process automation can be achieved by taking advantage of smart contracts, which enable the automatic processing of transactions if certain conditions are met: For example, if the arrival of a certain good is documented in the blockchain, e.g. by a sensor which documents the good's location, a smart contract can automatically trigger the payment process of this good based on the sensor's transaction. Smart contracts are saved in the blockchain and transparent to any member of the network.

While public blockchains like Bitcoin are permissionless, meaning that everyone can participate and issue transactions, private blockchains consist of a chosen consortium of users, making the blockchain inaccessible by the general public [9].

Relevance for practitioners

In the process of applying blockchain technology to different ecosystems, some business models are replaced as blockchain makes the processes more efficient and secure, e.g. auditors who get replaced by automated process audits [9]. On the other hand, new business models might be created, where the previous lack of trust between participants or economic inefficiency to build a partnership posed a challenge for a successful cooperation. For practitioners, it is important to be aware of use cases and application areas which benefit from blockchain technology.

Possible areas of application are vast, and new ideas how to apply blockchain to make business models better constantly evolve. The most known application area is Finance, with

Bitcoin being the most famous application. Cryptocurrencies and blockchain could potentially make banks obsolete, or at least improve processes such as the trading of foreign currencies, which is at the moment a time-consuming process but could be simplified by using blockchain [1,3]. Another application area is the Internet of Things (IoT): Transactions between smart objects, which happen without human interference, can be documented in the blockchain or even automatically triggered by using smart contracts [9]. An example for using blockchain for IoT use cases are smart locks, which enable an automated and safe way to rent objects and transfer the respective payment [2]. Smart grids, where private energy generators and energy consumers freely trade energy without going through an energy provider are an example which is already being implemented [6]. Blockchain might also revolutionize the way how the proof of origin for important documents or objects can be determined. Each document or object which is uniquely identifiable can be stored as a transaction in the blockchain which documents its owner [9]. This is for example being realized to track diamonds on the platform Everledger, and a platform to document digital certificates to provide a life-long learning documentation is currently being developed [5]. In the context of supply chain management, blockchain enables the tamper-proof documentation of changes of ownership and provides the possibility to automatically transfer funds between supply chain participants as the ownership changes [9]. Computer Supported Cooperative Work is not yet a widespread topic for blockchain research, but could be a promising application area [10]. Other application areas include, but are not limited to, medicine, media, the public sector or law.

Objective and Structure

Blockchain technology offers great potential for cost, time and efficiency improvements of existing business models. Therefore, practitioners need a structured guideline to analyze their business, find the right processes that are suitable for and can benefit from blockchain technology, and understand how blockchain can support these processes. To meet these needs, this paper proposes an analysis framework to guide practitioners in their blockchain implementation journey. This analysis framework consists of a two-step approach: At first, the user is supported in exploring which use cases are the most suitable for blockchain technology and afterwards he receives guidance on how exactly the new technology offers advantages for the specific use case. The goal of this analysis framework is not to give a simple yes/no answer to the question if blockchain is suitable, but it rather aims at helping practitioners develop a deeper understanding of how the blockchain could support their use cases.

To give this analysis framework some more context, a second section of this paper will explore related work, referring to other, popular frameworks and canvases. Afterwards, both the use case identification framework and the use case canvas will be introduced and described in detail. In the third section both the framework and the canvas are applied to some exemplary use cases to present how they can help practitioners in their blockchain decisions. The fourth section then explains how the analysis framework was developed and evaluated, before the last sections summarizes the advantages the framework offers, explains some limitations and proposes directions for further research.

RELATED WORK

Frameworks and canvases are often used to facilitate the application of complex theories to real-world use cases. They provide the user with a guideline on how to apply theoretical concepts to a specific application. One example is the Business Model Canvas proposed by Osterwalder and Pigneur [7], which helps to design and understand a business model by investigating its customer segments, customer channels, customer relationships, value proposition, key resources, key activities, key partnerships, revenue streams and cost structures. The interactions between those nine aspects summarize the overall business model. The Business Model Canvas provides the user with an open template that can be used to describe all nine aspects of his business model.

As a second example, design thinking is an approach describing creative design processes focusing on user needs. To facilitate this processes, frameworks have been developed to guide users through the process of design thinking. For example, the Stanford DSchool developed a playbook providing guidance on the five steps of design thinking, namely empathize, define, ideate, prototype and test [12]. For each iterative step, the Playbook provides the user with questions and instructions on how to apply design thinking.

Regarding blockchain, a framework to determine whether or not a blockchain is useful to solve a problem was proposed by Wüst and Gervais [14]. They present a flow chart which guides the user through several yes/no questions about their problem or use case, including the amount of partners in the network, the availability of a trusted third party and the level of trust with which the partners can be met. Depending on which path the user takes through the questions, the framework gives a recommendation of whether blockchain should be used, and if so, which type of blockchain (permissionless, public permissioned or private permissioned) would be the most appropriate.

USE CASE IDENTIFICATION FRAMEWORK

With blockchain technology being a growing topic of interest and an increasing amount of blockchain applications being developed, many businesses need to ask themselves how their business models are going to be affected by blockchain, and how they could use this new technology to exploit the advantages it offers for business model improvement. The proposed use case identification framework for blockchain displayed in Figure 1 addresses this challenge by providing guidance on the assessment of the suitability of specific use cases for blockchain technology.

To achieve this, the framework consist of the three categories *intermediary*, *data* and *process*. For a specific use case, these

three categories are evaluated separately regarding the blockchain suitability of the use case.

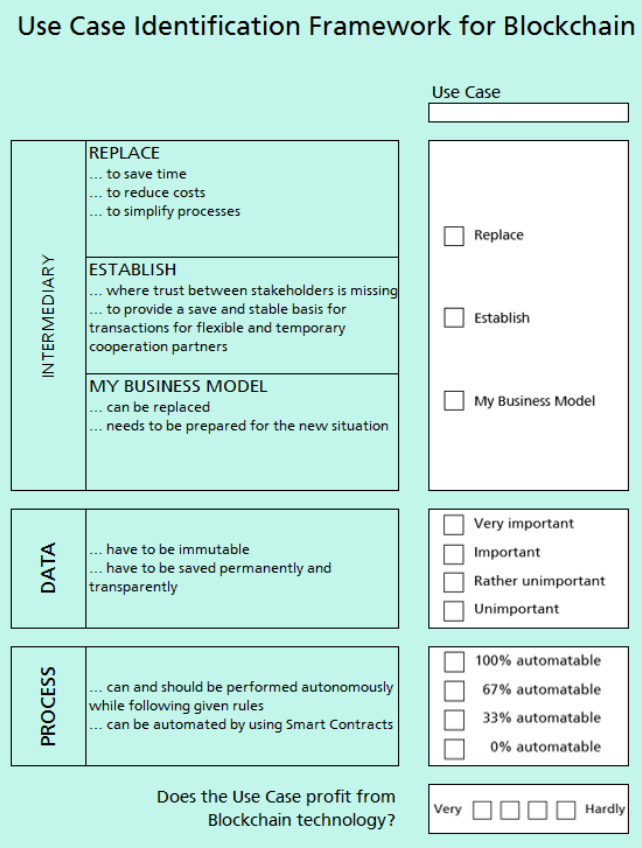

Figure 1: Use Case Identification Framework for Blockchain

The first category, *intermediary*, explores the existence and the role of intermediaries in the use case, since a blockchain functions as an independent and incorruptible intermediary. There are three scenarios in this category, *replace*, *establish*, and *my business model*. While the first two scenarios are usually relevant for anyone needing an intermediary for a use case, the third scenario is relevant for anyone functioning as an intermediary in a use case. Each scenario describes a specific situation and the user of the framework can decide which one, if any, is applicable in the use case. The first scenario, *replace*, describes a situation where an intermediary is currently existent and acting as a third party between stakeholders. However, the use of this intermediary might be time- or resource-consuming, or the process of interacting with other stakeholders through the intermediary could be tedious or complicated. In this case, blockchain technology could be used to save time, reduce costs or simplify the process.

The situation described in the second scenario, *establish*, is applicable for potential use cases where currently no intermediary is in place because there is a lack of trust between stakeholders and towards any possible intermediary. In this case, blockchain could provide a safe and stable basis for transactions without needing the partners to trust a third party, instead they can trust the technology. This blockchain scenario could be especially useful for flexible and temporary collaborations.

The third scenario, *my business model*, describes the situation from the view of an intermediary that could potentially be replaced by blockchain. In this case, possibilities to keep the business model useful for the partners in the network and provide added value compared to a blockchain need to be explored. To this end, blockchain technology might be used to provide the partners with a new solution and a better use case and thus preventing them to replace the old intermediary.

Since those three scenarios describe different situations from different viewpoints, usually only one scenario will be rated as true. If no situation is applicable to the use case, it might still benefit from blockchain technology, but it is probably not crucial to the use case.

The second category in the framework, *data*, assesses the use of data. Blockchain technology offers the possibility to save data permanently and transparently as well as preventing anyone from modifying the data after it has been entered into the blockchain. In this category, the user should evaluate how important those characteristics are to the data used in the use case. Depending on how necessary the protection of data from attacks and the permanent accessibility of the data are to the use case, the more important should this category be rated. The importance is measured on a four-point scale ranging from unimportant to very important.

In the third category, *process*, the potential for automation in the use case can be assessed. The user should evaluate if the processes contained in the use case can be (further) automated by designing rules to perform process steps autonomously. Since blockchain enables the use of smart contracts to automatically trigger transactions, those contracts can be used for automation purposes and thus for making the process more efficient. Therefore, if the use case would benefit from automation, blockchain technology could provide this automation. The user can evaluate the automation potential on a four point scale ranging from 0% automatable to 100% automatable.

After the assessment of each category for the use case, it needs to be evaluated whether the use case would overall benefit from blockchain technology. This is usually the case if one scenario in the category *intermediary* is rated as true and the other two categories, *data* and *process*, are rated as important/ automatable. The more positively the last two categories are being rated, the more suitable blockchain technology is for the use case. The evaluation of how much the use case would profit from blockchain can be assessed on a four point scale ranging from very to hardly. The user can then utilize this summarizing assessment to see if a single use case is suitable for blockchain, or, if several use cases were evaluated, which one would profit the most and should be implemented first.

USE CASE CANVAS

While the use case identification framework helps practitioners to identify which use cases are suitable for blockchain technology, there is still a need for understanding how exactly the blockchain would impact the use case. The proposed use case canvas for blockchain, partially displayed in Figure 2, enables the user to develop deeper insights into how a suitable blockchain would be structured. Additionally, it helps to identify the potentials that could be unlocked by using blockchain technology compared to the current use case without blockchain.

There are five categories presented in the canvas, which collectively describe relevant characteristics of a blockchain that would be suitable for a specific use case. The categories are *added value*, *data and process integrity*, *decentral network*, *values and rights*, and *automation* and for each category, the user can list all relevant aspects concerning this category in the canvas. Each aspect is then rated in the rating column with the rating high, medium or low, depending on how important this aspect is for the use case.

The first category, *added value*, is concerned with the difference the blockchain makes in the use case compared to the use case implementation without blockchain technology. Relevant aspects in this category are related to the tasks that are being supported by the blockchain, the processes that are being improved and how this improvement works, as well as which unique characteristics the use case gains by using blockchain as opposed to not using blockchain technology. Overall, this category assesses how the blockchain improves specific aspects of the use case implementation.

Data and process integrity, the second category, identifies which data needs to be managed securely. After having established in the use case identification framework that there is data being used in the use case that needs to be saved permanently and needs to be protected from data manipulation, it is now necessary to document which data exactly needs to be stored in the blockchain and which data can be stored in an external database or other legacy data warehouses, with references from the blockchain to the externally stored data. This category can thus be used to identify for which data it is crucial to be stored in the blockchain.

The third category explores the characteristic of a *decentral network*, which is one of the most prominent characteristics of a blockchain. Aspects in this category should document who, besides the user himself, are partners in the network.

Values and rights are the topic of the fourth category. Here, relevant aspects specify transactions that are being made on the blockchain for the use case. Blockchain in general is concerned with transferring values and rights between partners in the network, so practitioners should define which values or rights are being transferred in this use case.

The last category covers *automation* and describes which parts of the use case can be automated. If in the use case identification framework a certain potential for automation has already been identified, the canvas can then be used to specify which processes in the use case or which specific tasks in a process can be automated by using smart contracts specified in the blockchain.

After having collected all relevant aspects in these five categories, a better understanding of how a blockchain application would be structured for the specific use case should have been achieved. The canvas enables practitioners to clearly see the benefits of blockchain technology in combination with the specific use case as well as to understand the different components of the blockchain: Which data is stored on the blockchain each time a transaction is being made, who are the partners who exchange transactions with each other, which values and rights are transferred by the transactions and how the creation of transactions or whole processes can be automated.

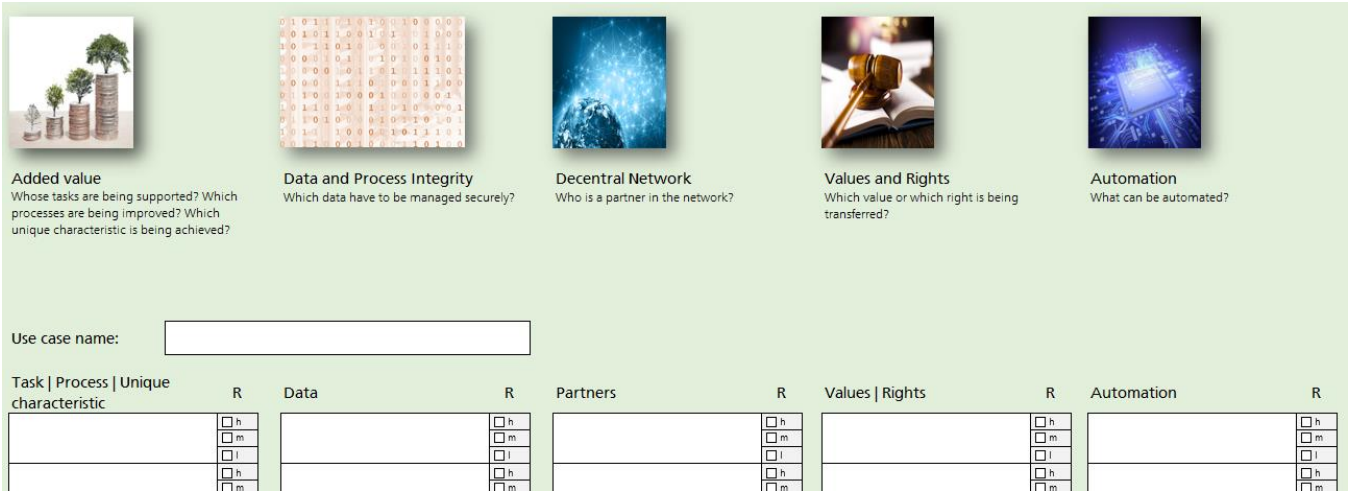

Figure 2: Use case canvas for blockchain

APPLYING FRAMEWORK AND CANVAS TO IDENTIFY AND STRUCTURE A SUITABLE BLOCKCHAIN USE CASE

Four use cases

In order to create a better understanding of how the framework and the canvas work in analyzing use cases, four use cases are going to be described and used as examples. The first use case describes the process using smart locks. Smart locks are a typical example for an IoT use case, since they enable a blockchain to manipulate physical objects [2]. If the owner of a smart lock decides that he wants to rent an object of his, like a house, a car or a bike, he can use the lock to secure his property and document the price and deposit amount for a specific rental period in a smart contract on a blockchain [8]. If someone wants to rent this object, this person can transfer the required price and deposit amount as a transaction on the blockchain, enforcing a smart contract which automatically sends a virtual key to the phone of the renter, enabling him to open the smart lock with his phone. The rental period can then be terminated again by another transaction in the blockchain, or if the rental period is over, which again enforces a smart contract which automatically returns the virtual key and re-transfers the deposit amount back to the renter. Smart locks are currently being developed as "Slocks" by the German company Slock.it.

The second use case involves smart grids, an opportunity for energy consumers to achieve independence from large energy providers. Inside a closed community, private, small-scale energy producers, for example households with photovoltaic systems, are enabled to sell their superfluous energy to neighbors who need energy [6]. This is realized by using a physical power distribution microgrid, connecting the different houses, and a virtual microgrid, connecting the smart meters that measure and monitor the energy generation and demand of every household. In a blockchain, smart contracts perform auctions by matching all buy (people who need energy) and sell (people who have energy to sell) offers and documenting every energy transaction on the blockchain. This way of trading energy can lower taxes and surcharges as well as providing nearly real-time access to energy whenever it is needed. This use case is currently realized as a prototype in Brooklyn, New York.

Foreign currency payments present the third use case. With regular bank transactions, transferring funds between currencies usually takes a long time and results in high fees [3]. Cryptocurrencies already enable people to make world-wide payments without a bank as an intermediary, endangering the business models of banks, as blockchain threatens to replace them. To prevent this from happing, banks can establish their own blockchain with banks from all over the world as partners on the blockchain, allowing them to transfer funds on the blockchain without any currency barriers [11]. With this use case, customers keep their level of comfort as they can still use their regular bank for international payments, but receive the benefits of fast transaction speed and lower fees.

As a last use case, the exchange of internal invoices will be investigated. In large companies with several subsidiaries, documentations of all transactions between the subsidiaries and the parent company are crucial. However, instead of using separate databases for this documentation, one central system should be used to make the transactions and the amount of money that is being accounted transparent. By using a blockchain, these transactions can be documented without the possibility of later manipulation while providing the necessary transparency. Any discrepancies between the accounts of two transaction partners are therefore being prevented.

Applying the framework

To demonstrate the application of the use case identification framework, the four use cases presented will be evaluated separately to analyze their suitability for blockchain technology. The completed framework for all use cases is displayed in Figure 3. Firstly, the use case of smart locks, which enable the automatic administration of virtual keys to objects, is going to be evaluated. Concerning the first category, *intermediary*, smart locks can be used to make it easier for landlords to rent out their properties, since they don't have to hand over a physical key. This "contactless" key transfer was previously not possible. Previous intermediaries could have been neighbors or friends of the object owner, however, those kinds of intermediaries would not necessarily have been trustworthy or always available. Therefore, since there hasn't been an intermediary comparable to a blockchain before, no intermediary is being replaced. However, the blockchain establishes a new intermediary and solves the problem of the lack of a trustworthy and available intermediary for flexible and temporary transactions. Since there was no previous intermediary, no business model is being replaced. Therefore, in the first category, the second scenario can be rated as being true. Regarding the second category, *data*, the immutability and transparency of the rental price and duration for each rental agreement is necessary, since it involves financial data and possibly impacts valuable properties of the owner. Financial data is always very sensitive, and the save handling of the virtual key is of great importance to the owner, thus the secure documentation of transactions can be described as being very important. Finally, evaluating the third category, *process*, the owner only needs to set a price and deposit amount once, and then automatically receives the payment every time his property gets rented. The tenant needs to trigger the renting process by transferring the rent and deposit amount on the blockchain, and then automatically receives the virtual key. Therefore, the process is not completely automatable since it requires input from the owner and the tenant, however, important aspects of the process can be automated. In conclusion, the use case does benefit from blockchain technology since one scenario of the first category is true and both the data and process categories are rated highly. However, since the process category does not receive the

highest ranking, and thus the use case cannot fully exploit the automation potential, it is not rated as benefitting very much from blockchain technology.

Smart grids as alternatives to the traditional system of large energy providers are the second use case being evaluated. Regarding the category *intermediary*, the blockchain-based microgrid replaces the traditional energy provider to save time in energy distribution by distributing energy only locally. Additionally, costs are being reduced by minimizing taxes and fees that are normally required by large providers. Thus, in this use case, blockchain replaces the large energy providers as intermediaries by saving time and reducing costs. In the traditional model, the energy provider acts as the intermediary between power plants and energy consumers and the consumers trust them: Thus, even with the previous intermediary, a trustworthy basis for transactions is available and the blockchain is not meant to establish one that was not existent before. Furthermore, although from the point of view of the energy provider, his business model can be replaced by the blockchain-based smart grid, in this example the use case is evaluated from the point of view of the energy consumer, thus there is no business model endangered. Looking at the second category, *data*, the data stored in the blockchain includes the amount of energy traded and the associated price for every transaction. To ensure a transparent documentation of every trade and to prevent discrepancies, the transaction data needs to be safe from manipulation and needs to be stored long-term in order to enable the verification of previous transactions. However, since the data are not necessarily as sensitive as for example financial or medical data, the importance of the category is not rated with the highest value. Regarding the third category *process* on the other hand, the automation potential can be rated with the highest possible potential. The use case does not require the energy consumers or producers to actively trade energy and therefore ensures the same comfort the consumers enjoy with traditional energy providers, while at the same time relieving the producers from doing any work. The smart meters installed at every house are able to measure energy deficiencies and surpluses and thus know exactly how much energy the network participant can sell or needs to buy. Smart contracts can then automate the energy transactions by arranging the auctions which match the buy and sell offers, thus, the whole process can be automated. In summary, the second use case also benefits from blockchain technology, since one scenario in the first category is rated as true, and both the second and third category are rated positively. Although the importance of secure data only receives the second highest value, the automation potential for this use case is extremely high. In this case, the process category influences the overall result more strongly than the data category, as the use case can make full use of smart contracts. Therefore, smart grids would benefit very much from blockchain technology.

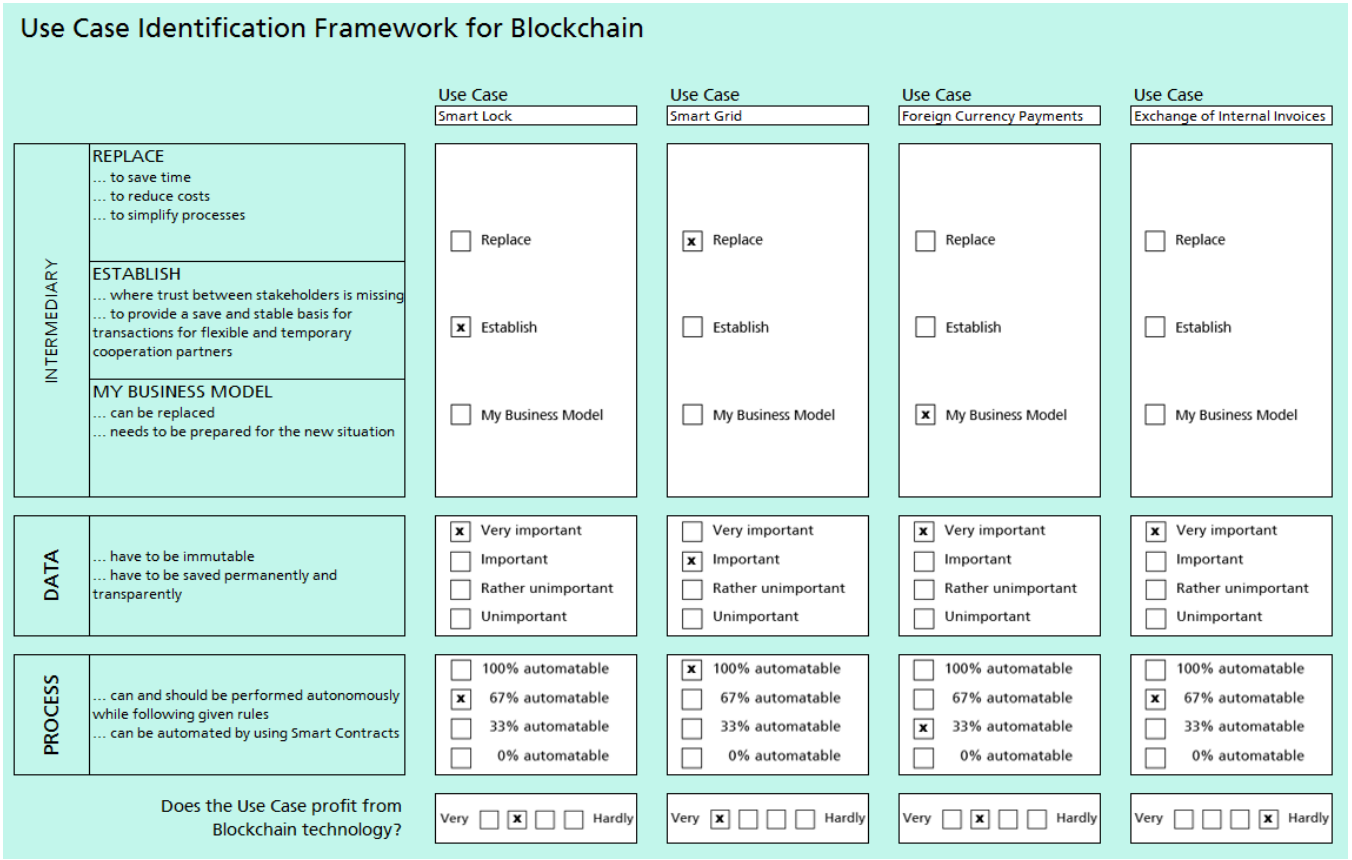

Figure 3: Use Case Identification Framework with examples

The third use case, foreign currency payments, presents another interesting example. Regarding the *intermediary*, the blockchain is being established as an intermediary between banks, however, the bank as the visible intermediary between two parties of a financial transaction does not get replaced, although time and cost benefits can be realized. Therefore, the blockchain does not replace an existent intermediary. Furthermore, since even without the blockchain an intermediary for international financial transactions is existent, no new intermediary is being established by using a blockchain. Nonetheless, for the banks, thus the intermediaries themselves, the blockchain provides a new, comfortable basis for flexible transactions. However, the motivation for this use case lies in the danger of the bank's business model being completely replaced by blockchain. Thus, to prevent two parties from making foreign currency transactions on a public blockchain without a bank as an intermediary, the bank itself needs to find a way to keep its customers, in this case with the private blockchain between banks. As a result, for this use case the third scenario in the first category is true. Concerning the *data* category, data from financial transactions are very sensitive, thus it is very important that those data are protected from manipulation. Additionally, banks need to be able to verify their payments, thus all payment transactions need to be transparent and made available permanently. Therefore, a documentation of transactions as it is possible with the blockchain is rated as being very important. Taking a look at the possible *automation*, the automation potential of this use case is not very high. Although the blockchain would enable banks to transfer money fast and cost-effectively within the blockchain, a complete process automation from the customer request to the transfer between banks to the transfer of the foreign bank to the foreign customer can probably not be completely automated. Nevertheless, a partial automation is possible and necessary for the fast processing of international payments. As a conclusion, although this use case would make international payments not as fast as direct transactions between two parties on a blockchain and although the process is not very automatable, the blockchain fulfills all requirements necessary for the handling of sensitive financial data. Additionally, it is a very important use case for banks to consider, since it enables them to compete with public blockchains and keep their customers. Therefore, banks would benefit from blockchain technology for this use case.

The fourth and last use case describes the exchange of internal invoices between subsidiaries and the parent company. In regard to the first category, *intermediary*, a blockchain would replace an already existing internal system of documenting transactions. However, it could not completely replace this system, since not all data can be saved on the blockchain and thus an external database to which the blockchain could reference would still be necessary. Furthermore, time and cost savings could probably not be realized since transaction data would still need to be manually entered and the process of doing this would not be simplified. Additionally, all subsidiaries would most likely still be required to maintain their own, separate accounts. Therefore, replacing the existing system would not be beneficial. Since without the blockchain as an intermediary, an internal system already exists, no new intermediary can be established. Also, the intermediary being used as well as the users of the system are both part of the same company, thus the possibility of a replacement is no threat to the company since it can always actively decide against it. Therefore, the potential replacement of an intermediary is no motivation for the company to realize a blockchain use case. Analyzing this first category, none of the three scenarios can be rated as true, which means that the use case would hardly benefit from blockchain technology and in general, the analysis could stop at this point. However, in this evaluation the second and third category are also being assessed to provide a complete analysis. The data being handled in this use case are sensitive financial data that need to be protected from manipulation. Additionally, transparency and long-term availability is necessary to avoid discrepancies in the records of different subsidiaries, thus, the importance of data immutability and transparency is very high. Regarding the process, the use of blockchain for the exchange of internal invoices could not offer significantly more automation potential than any other system. Although smart contracts can be used to automate parts of the process, this can also be done with different systems, thus, the automation potential is not a motivation for using blockchain technology in this process. In conclusion, since no scenario in the first category can be rated as true and additionally the automation potential by using smart contracts is not very high compared to other systems, this use case would hardly benefit from blockchain technology.

Applying the canvas

After all 4 use cases have been evaluated, 3 use cases are considered as being able to benefit from blockchain technology, while one use case is not suitable for using blockchain. In this next step, one use case will be analyzed more deeply by applying the use case canvas and evaluating the 5 categories explained in the canvas. For this purpose, the smart locks use case will be used.

Firstly, there are two main characteristics of the blockchain application in this use case that provide added value compared to any existent solution: The first benefit is the absence of any physical key: Instead, the virtual key can be transferred to and from users without the requirement of the physical presence of an intermediary. The second benefit is that the owner of the object is guaranteed to receive the rental money and deposit amount, since the smart contracts ensure that the virtual key is only transferred if the money has been paid. If the rental period is over, the key is automatically taken away from the phone of the one using the object. Thus, he cannot keep using the object unless he transfers more money to the owner on the blockchain. The immutability of smart contracts is one of the main values of blockchain

technology, once the rules of a smart contracts are set, they cannot be manipulated. Furthermore, since the absence of a physical key is a new and unique improvement compared to previous processes, and the owner does not need to worry about missed payments, both benefits have a high rating.

Secondly, four types of data need to be stored on the blockchain: The deposit amount, rental price and rental duration for which the rental price is valid are necessary for the smart contracts to correctly release the virtual keys. The owner of the object needs to determine these values and save them on the blockchain in a smart contract. Additionally, since the smart contract triggers the transfer of the virtual key to the user of the object as soon as he made a correct payment, data related to this virtual key needs to be saved on the blockchain, to make sure that the correct key gets transferred and to ensure the security of the key. All four types of data have a high ranking, since transparency and immutability of the transactions can only be guaranteed if all of these data are saved on the blockchain.

Thirdly, the blockchain is a decentralized network with several partners, so it needs to be determined who needs to have access to the blockchain. On the one hand, the owners of every object secured with a smart lock need to be able to access the blockchain to create smart contracts related to their smart lock. On the other hand, people who want to rent these objects also need access, to be able to make the necessary transactions to trigger the smart contracts. Since the concept only works with both network partners, both have a high ranking. This concept suggest the use of a public blockchain, to ensure the availability to every person interested in the secure renting of objects. However, for closed communities a private blockchain could also be suitable. An example for this kind of community could be carsharing, where users need to register to be able to rent a car whenever they need one, which could provide the car owners with an additional feeling of security.

The fourth aspect of the canvas is concerned with the values or rights that get transferred on the blockchain, i.e. the purpose of the transactions stored on the blockchain. In this use case, the right to use an object for a specific price and duration gets transferred to the one renting the object. This right can be received by transferring money on the blockchain, and will be revoked after the rental period is over, therefore, it also receives a high ranking.

Lastly, the automation aspect investigates which parts of the process can be automated with smart contracts. With smart locks, the key transfer in the beginning and the end of the rental period is completely automated after the transfer has been triggered by the payment of the price and deposit. Additionally, after the person renting the object has made the payment, the further handling of the money is also automated, meaning the deposit amount is kept on the blockchain and later automatically re-transferred after the virtual key has been returned. However, for the advantages the blockchain offers for the use case, the first automation potential is more important than the other one, therefore it receives a high ranking, while the importance of the second automation scenario is ranked as medium.

EVALUATION OF FRAMEWORK AND CANVAS

Both the use case identification framework and the use case canvas were developed in an iterative way. A first version of the canvas was designed to provide a tool for a better understanding of the requirements that a certain use case would have for a blockchain. This version already included the five categories. After some testing, it was realized that sometimes several possibilities exist to implement a suitable blockchain, therefore it was decided to add a rating to every aspect of every category to prioritize which aspects are must-haves (high rating), should-haves (medium rating) or could-haves (low rating). Additionally, the description of every category has been refined in several steps in order to achieve the best possible guidance on evaluating the use case. However, after several use cases had been utilized to test the canvas, it became clear that the canvas is most useful if a basic understanding of the usefulness of blockchain technology for a specific use case is already present. Therefore, to prepare use cases for the application of the canvas, a framework was developed to identify suitable use cases. This framework should use three main characteristics of blockchain as categories to find out if these characteristics are needed in the use case. In the first design, open spaces were used for each category and scenario to enable the user to describe how each aspect gets evaluated. However, after testing the framework, feedback emerged that with the open text boxes, it does not become clear what the user should include, and additionally redundancies between the application of the framework and the canvas can occur. Therefore, it was decided to adapt the framework and use multiple choice questions to better fit the need for a simple-to-understand, useful tool to evaluate blockchain suitability.

Evaluation of the framework and the canvas was conducted both internally and externally as soon as the first designs were finished. Internal testing included the research of possible use cases in several domains, which would then be used to apply the framework and the canvas. This internal testing lead to some revisions and redesigns. After the internal testing, an external workshop with a large German telecommunication provider which was organized by the authors of this paper was used to receive further feedback. The workshop participants made a list of 9 use cases which they encounter in their every-day work life, and then applied the use case identification framework to 7 of these use cases while working together in small groups. After 5 use cases have been identified as being generally suitable for blockchain technology, the use case canvas was applied. After this application, those use cases were discussed with all groups, to receive 4 prioritized use cases for blockchain applications. During the workshop, the participants were observed to find out how well the framework and the canvas suited their needs for the task they had to perform. Additionally, feedback was collected after the workshop.

This external evaluation was then used to make further adjustments to both the framework and the canvas.

DISCUSSION AND CONCLUSION

Value of Framework and Canvas

The identification framework and use case canvas presented in this paper will aid in guiding practitioners in exploring blockchain opportunities and deciding which parts of their business could benefit from blockchain technology. There are two possible scenarios in which framework and canvas would help practitioners in the beginnings of their blockchain implementation: In the first scenario, a practitioner might be interested in blockchain, but is still unsure which use cases of his company could benefit from the new technology. He can then use the framework to gain a first overview on possible use cases and to rate the suitability of each of those use cases to prioritize future implementations. In a second step, he can then use the canvas to further explore highly prioritized use cases and gain an understanding on how a blockchain for this use case could be used. As a result, he has a list of suitable use cases and knows how blockchain could improve those use cases. He can use this input to further guide the implementation of one or several blockchain applications.

In a second scenario, another practitioner might have a specific use case in mind that she would like to use blockchain for, but she has no real knowledge on how the implementation of blockchain technology for this use case would look like. To change this, she can use the canvas to explore the different aspects of a blockchain and use this as a first draft for a later implementation.

While both the framework and the canvas can be applied separately, they also work together very well. The framework explores the basic suitability for blockchain, while the canvas uses the results from this analysis to elaborate on the specific advantages and functions the blockchain enables for a certain use case.

Integration into the research environment

The proposed use case identification framework and use case canvas can be integrated into the research environment by comparing them to the related work. The Business Model Canvas [7] as well as the design thinking approach [12] have very exploratory characteristics. They guide the user through different categories by explaining them and inviting the users to apply them to their own use cases. While the Business Model Canvas has nine distinct categories which in combination provide the user with a complete understanding of the business model, the design thinking approach guides the user through an iterative refinement process resulting in a finished prototype. While both approaches are rather creative and open, the use case canvas described in this paper is comparable to the Business Model Canvas, as it also explains 5 distinct categories of blockchain application which need to be understood and applied separately to gain a complete understanding of the use case. Since the Business Model Canvas is now a broadly used tool in the business sector, it can be anticipated that the use case canvas could meet the same approval and usefulness.

A comparison with the framework proposed in the paper by Wüst and Gervais [14] is especially interesting since they discuss the same topic: Blockchain adoption. They exclusively use yes/no questions for their framework which could be answered independently, guiding the user through several questions to reach a conclusion regarding which type of blockchain, if any, should be used. In the framework proposed in this paper, the first category also consists of yes/no questions, however, they are structured differently, because the user needs to understand all three scenarios in order to decide which scenario fits his use case. For the evaluation of the other two categories, the user needs to decide on an answer based on a four-point scale, meaning he has to carefully evaluate the category before deciding on an answer. In general, the framework described in this paper is more open in that it does not simply offer a yes/no answer, but the possibility of prioritizing several possible blockchain use cases and understanding why each use case is more or less suitable for blockchain.

Evaluating the type of questions asked in both frameworks, the one proposed in this paper presents three main characteristics of blockchain (the role of an intermediary, data immutability and transparency, smart contracts) and aims at exploring how much the use case that is being analyzed needs those characteristics. Wüst and Gervais also explore the intermediary characteristic by asking questions about the amount of partners in the network, which directly leads to the necessity of an intermediary, whether or not they are known, the amount of trust that these partners enjoy and the existence of a trusted third party, the intermediary himself. They also mention the data category, but only ask a question about the requirement of long-term storage, without explaining data immutability and transparency. They also do not mention the possibility of process automation by using smart contracts. Instead, they give a recommendation about which type of blockchain would be the most suitable (permissionless, public or private permissioned). Furthermore, they use 6 questions in their framework but in most cases the user only answers a few of them, since at almost every decision point, one answer leads to the “Don’t use Blockchain” decision. This means that the decision process might be terminated after only one question, which is probably not suitable to provide a high-quality blockchain decision. Instead, it might be more suitable to first decide whether or not a blockchain should be used, then to understand what characteristics this blockchain should have and then use this knowledge and understanding to make a well-founded decision about the type of blockchain. The proposal of first using an identification framework and then a canvas supports this viewpoint and aims at providing comprehensive guidance on the application of blockchain technology to a specific use case.

Limitations

There are some limitations to the analysis framework presented in this paper. Firstly, other than the paper by Wüst and Gervais [14], no decision on which type of blockchain would be the most suitable is being made. However, a well-founded decision on this question can only be made after the information gathered in the canvas has been completed, and would therefore needed to be realized as a third step to the analysis framework. It is therefore outside the scope of the framework and canvas presented in this paper.

A second limitation would be that there are no clear rules regarding which results in the three categories of the identification framework lead to which decision regarding the final question of how much the use case would profit from blockchain technology. This ambiguity could however benefit the user, since it requires him to really understand the use case and its requirements.

Lastly, the framework does not include a category acknowledging those blockchain characteristics that could negatively influence the decision to adopt blockchain, for example the issue of data privacy which receives increasing importance with the new GDPR regulation. Adding such a category could be included in future refinements of the analysis framework.

Future Work

Future work founding on the results of this paper could include additional studies with practitioners to test the framework and canvas. Workshops with companies could be used to further improve the analysis framework and test its applicability for different industries.

Furthermore, another refinement of the identification framework could include a prioritization of the data and process categories as well as a coding of the answer possibilities with numeric values, which could then be used to calculate an overall score for each use case to aid in the decision making process.

Lastly, the two-step approach of the analysis framework could be extended to a three-step approach, with the third step including a transaction model of which transactions are being written on the blockchain and an overview on the smart contracts used for automation. This step could also include the selection of a suitable blockchain technology, e.g. if a public or a private blockchain would be most suitable. It should also be noticed, that the analysis framework is based on the currently available blockchain technology, and should be adjusted if technological advances are being made.

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