BLOCKCHAIN APPLICATIONS IN BUSINESS PROCESSES EXEMPLIFIED FOR PROCUREMENT

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The purpose of this article is to introduce the application of the blockchain technology to a specific business process in procurement and to provide an updated concept. The blockchain technology is a very promising technology and facilitates a variety of applications for digitalization in business processes. Many appliances are already in use and benefits in terms of effectivity and efficiency can be stated. The transfer to procurement will be made on a conceptual basis.

The scientific approach is analytical and theoretical, answering the research question about the applicability of the blockchain technology in business operations, exemplarily analyzed for the procurement management process. The application of this digital technology in the context of the procurement activities is described. In order to do this, a generally admitted procurement process is introduced as a basis for scientific discussion.

In summary, three major applications of the blockchain were identified and their impact on the procurement department is depicted. The major issues are smart contracts, tracking of the supply chain as well as crypto currency. Specific advantages and disadvantages are pointed out. Finally the findings will be transferred to the procurement process.

Key words: *blockchain, procurement, processes, smart contracts, supply chain, crypto currency*

1. Initial situation

The blockchain idea is meanwhile very common and yet realized in various applications. In 2009 Satoshi Nakamoto launched the crypto currency Bitcoin, and people discovered the possibility to gain money out of it. Since that time the interest in the blockchain technology behind the Bitcoin increased steadily. First the interest and investments concentrated on crypto currency, but in the last few years it shifted to the general application possibilities of the blockchain technology in different business areas. Experts estimate, that the market capitalization of the blockchain technology will increase from USD 604.5 million in 2016 to USD 7.59 billion by 2024. This means on average an annual increase of 37.2% over the period of eight years (Grand View Research 2018).

One of the possible areas, in which the blockchain technology could play a major part, is procurement. And yet the Supply Chain Management (SCM) is an important part of the procurement management. On the other side, also the sales process (Hofbauer/Hellwig 2016) as the counterpart of the procurement process (Hofbauer 2017) will benefit from applications of this technology.

The research question of this article is about how industrial procurement could benefit from applying the blockchain technology. Related to that question is the impact on competitiveness. New technologies support competitive advantage. There could be a need of companies to adapt the blockchain technology to stay competitive. These questions of research will be led to a favorable answer. In the first step the procurement process will be introduced in general. In the second step three possible blockchain applications, which are the most appropriate ones for the procurement process, will be verified. The affected process phases of the procurement process will be depicted in the summary.

The scientific aim of this article is to contribute to the digitalization of business processes in general and to provide a contemporary application to the procurement process in particular.

2. The Buying Cycle as a basic business process

The Buying Cycle as a typical business process is chosen for analysis. The Buying Cycle (Hofbauer 2017) was introduced to mirror all relevant steps in procurement management. The well specified procurement process is a comprehensive elaboration of all relevant steps of execution, which are combined with defined input and output relations. The procurement process according to the Buying Cycle is arranged in four different groups of tasks: Planning, Selection, Transaction and Monitoring

Among those groups of tasks, there are eleven subtasks which are considered as a workflow:
- Organization
- Identification of requirements

‒ Market analysis
‒ Qualification of suppliers
‒ Quotation processing
‒ Primary treatment
‒ Negotiation
‒ Management of orders
‒ Utilization
‒ Supplier Development
‒ Controlling of procurement

The process cycle with the aligned 11 process phases is shown in figure 1 (Hofbauer 2017, p.25).

Figure 1 The Buying Cycle (Hofbauer 2017, p. 25)

3. Application possibilities of the blockchain

The statements in this chapter about the blockchain applications are based on extensive literature research as well as conceptual considerations. Summing up the findings, there are three main application possibilities in the procurement process as a deliverable.

The process introduced in chapter 2 shall serve as the exemplified procurement process relevant for the statements of this paper. On this basis the blockchain technology is applied to this process. In summary there are three main applications identified for utilization in the procurement process: smart contracts about transaction agreements and fulfillment, monitoring in terms of tracking and tracing of the supply chain and payment for transferred goods and services with crypto currency. Each of these findings will be associated to the specific relevant process steps in procurement management. In summary an overview is given about the fields of the Buying Cycle, where the blockchain technology can be used. Advantages and disadvantages will be itemized as well.

3.1 Verification through Smart Contracts (SCo)

There are various definitions of smart contracts described in literature. Since the focus in this paper is the analysis of smart contracts in blockchain applications, the following characteristics will serve as a basis:
‒ Details of smart contracts are saved on a shared platform (blockchain)
‒ They get executed by blockchain transactions
‒ As the characteristic of the blockchain in general, a smart contract is also accomplished by many computers in the same network (usually the same computers that also run the blockchain)
‒ The recorded data of smart contracts will also be saved in the blockchain

Smart contracts represent a new idea in documentation and execution of agreements. But they imply two

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main issues that prevent their use. First of all, there was no possibility to control the physical assets by smart contracts. Secondly the missing trustworthy, because computers execute autonomously these smart contracts between two or even more participants. These issues could be eliminated by the blockchain and therefore smart contracts are now increasingly considered.

Figure 2 illustrates the different approaches between traditional transactions (left) and smart contract enabled approach (right).
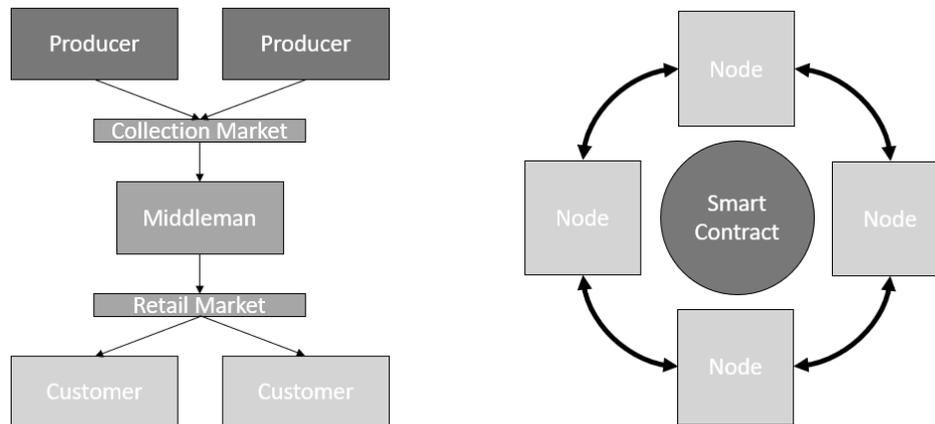
Figure 2 Traditional (left) vs. smart contract enabled markets (right) (Asharaf/Adarsh 2017, p.46)

The advantages and disadvantages of smart contracts are listed, before their application is transferred into the procurement environment (Morabito 2017, pp. 102-105).

3.1.1 Advantages of SCo in business processes

- <u>Autonomy:</u> Smart contracts are executing the contract automatically, when all prerequisites and criteria programmed in the contract are fulfilled. There is no need of additional trust between those parties entering into the contract and no need of trust to a third party monitoring the contract, e.g. a credit card company.
- <u>Money saving:</u> Third parties are not necessary anymore, so money can be saved. Bank transactions are not needed and service fees of banks are not being charged for transactions. Also changing the contract is relatively economical since you only need to change the program code. This is usually easy, if there is an experience in programming.
- <u>Fast and efficient:</u> Transactions can be executed faster and more efficient, because there is no need of middleman transactions. As soon as the needs of two or more parties are matching, the smart contract will be triggered and the transaction is executed as soon as the next blocks are mined.
- <u>Anonymity:</u> As one of the main characteristic of the blockchain also smart contracts can be executed anonymously. There is no need to reveal the identity of the participants to fulfill the transaction.
- <u>Transparency:</u> As with the crypto currency also the transactions initiated by smart contracts are recorded in the blockchain and are not changeable belatedly (Morabito 2017, pp. 115-116).

3.1.2 Disadvantages of SCo in business processes

- <u>Lack of flexibility:</u> Smart contracts are only able to execute transactions pre-programmed into the software code, they cannot be varied dynamically. It is not considering the real-life situation that often, after a deal is done the contracting parties may modify it, because of unforeseen circumstances. For example, if you buy something online and select a shipping date, the smart contract will hold your money until it gets the notification that the delivery took place. But the courier company instructed by the online shop delayed the delivery, so the smart contract gets the information "no delivery" and send the money back to the buyer.
- <u>Difficult to understand:</u> For the majority of the population reading a contract written in their native language or even in a foreign language that they are proficient in is a lot easier than the software code programmed in the smart contract. Especially lawyers, that will be needed to check those smart contracts before a company uses them, need either to inform themselves about the programming of those codes, or need to work together with a programming specialist.
- <u>Acceptance problems:</u> With the introduction of smart contracts companies accept to cede control about contracting to a digitized process that cannot be influenced anymore without the acceptance of all involved partners. Since the technology is relatively new and not extensively tested, it will be hard for companies to accept this cede of control (Asharaf/Adarsh 2017, p. 50).

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3.1.3 Application and impact on SCo in procurement

With the lack of flexibility in traditional execution, smart contracts in procurement processes right now are mostly useful for the purchase of uncomplicated material, for example raw material. It could work like this:

A supplier in the automotive industry needs aluminum for the production of a part of the car. Since the whole supply chain of the automotive producer is connected through a blockchain with smart contracts for aluminum, the supplier only needs to create a block in which all requested details are entered (e.g. quantity, price per ton etc.). After the information is mined into the blockchain, the smart contract will immediately search in the blockchain for a matching offer and if it is successful, the contract will be instantly set into force and executed. There is no need to request for quote and offer neither to wait for feedback of the supplier, followed by negotiation (see figure 3).

The following phases in the procurement process may be influenced by introducing smart contracts into a company:

- Organization:
  - o New process parts need to be introduced
  - o New qualifications or training are required
  - o New information systems have to be installed
- Quotation processing:
  - o Inquiries are no longer addressed directly to one supplier, but to every enrolled and accepted supplier in the blockchain
  - o A lot of tasks (e.g. the comparison of offers) will be executed by smart contracts
- Primary treatment:
  - o This phase is not necessary anymore, since details formerly to be clarified here (e.g. delivery terms) already have had to be clarified by entering the inquiry in the blockchain
- Negotiation:
  - o Not necessary anymore, since smart contracts cannot consider subsequently negotiated details anyway
- Management of orders:
  - o No need to take care of the payment management anymore, since smart contracts are taking over control and execution here
- Utilization/Supplier Development/Controlling of procurement
  - o Use the recorded data in the blockchain for evaluation (KPI's)
  - o Availability and cost control
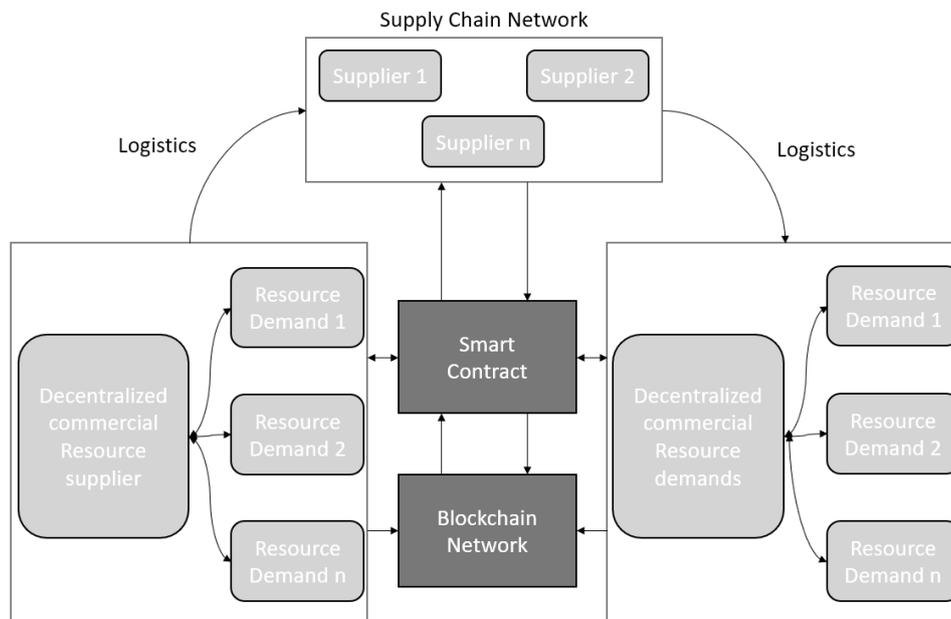
Figure 3 Example of smart contracts applied on a supply chain network (Kaijun et al. 2018, p. 5)

3.2 Tracking and tracing of the Supply Chain (SuC)

In contemporary supply chains it is absolutely necessary to track and trace the shipped goods. The supply chain of the food industry for example needs to track the way of their goods made from the producer to the supermarkets to verify perfect delivery conditions (e.g. temperature) during the whole time and be able to verify the origin of the goods (e.g. regional fruits and vegetables) to the customer.

In the diamond industry a company called Everledger invented a blockchain based system that is using laser-inscribed serial numbers and digital thumbprints of attributes to proof the origin of the diamonds. Even the way they made from the mine to the buyer is recorded to avoid fraud and the trading of forbidden diamonds.

Another approach for the automotive industry could be to track exactly every single item of their cars and record it into a blockchain. The buyer of a new car would be able to check the supplier delivering parts of his car and the origin of the raw material used to produce this car. This could be an enormous competitive advantage considering the increasing importance of compliance and sustainability in the automotive industry and similar ones (Asharaf/Adarsh 2017, pp. 77-78).

As in the two chapters before the advantages and disadvantages of tracking the supply chain in the blockchain will be listed and then the transfer into the procurement processes will be made.

3.2.1 Advantages of SuC in business processes

- <u>No fraud:</u> As already mentioned the data recorded in the blockchain are not changeable belatedly. There is no possibility for one of the participants of the supply chain to change the data for his own advantage, for example to hide a fault in cold chain of a food transport or using the raw material of a questionable source.
- <u>Real time tracking:</u> If there is any issue damaging the rules of transport or damaging the transported good directly the real time data that is continuously recorded in the blockchain can immediately notify the demander, so the product can recall and start a new request on the needed good a lot faster as if only at goods receipt the damage is determined (Deloitte 2017, pp. 3-5).
- <u>Changing customer interests:</u> The world is always changing leading to different customer interests over the years. One of the current trends is the customer's interest in sustainability. With a transparent and well recorded supply chain being visible for the customer companies may be able to establish customer loyalty (SolarCity 2017, p. 2).

3.2.2 Disadvantages of SuC in business processes

<u>- Hard to install:</u> Installing a system that is tracking the entire supply chain the whole time uploading the recorded data online into the blockchain and even in real time is an enormous challenge and only worth if the use of a transparent supply chain is exceeding the costs (Deloitte 2017, p. 7).

3.2.3 Application and impact on SuC in procurement

With the real time update of data recorded during the production and transportation of a good there is no need any more to provide these data manually to your customer. The customer will be able to get the information directly out of the blockchain without any disbelief that the data could be incorrect. This will facilitate the work of the procurement department since some of their processes may become unnecessary.

The following process phases in the procurement cycle may be influenced by introducing a tracking system of the supply chain based on the blockchain technology into a company:

- Management of orders:
    - o The monitoring of delivery will be an automated process, which is only notified by the procurement department, if an intervention is required.
    - o The incoming inspection may be a lot easier since any possible damage done to the good is recorded in the blockchain and the inspectors may already know what they need to look for.
- Utilization:
    - o The logistical performance of the supplier can easily be rated by the data recorded in the blockchain.
    - o If there is any need of reclamation you can easily find out the failure in production or during transportation.
- Supplier Development
    - o With the rating of the supplier's logistical performance it can easily be figured out, where the best leverages are to improve his performance

o Monitoring the suppliers is a lot more transparent and easy by using the blockchain

The comparison of the traditional automotive supply chain and a possible future automotive supply chain is provided in figure 4.
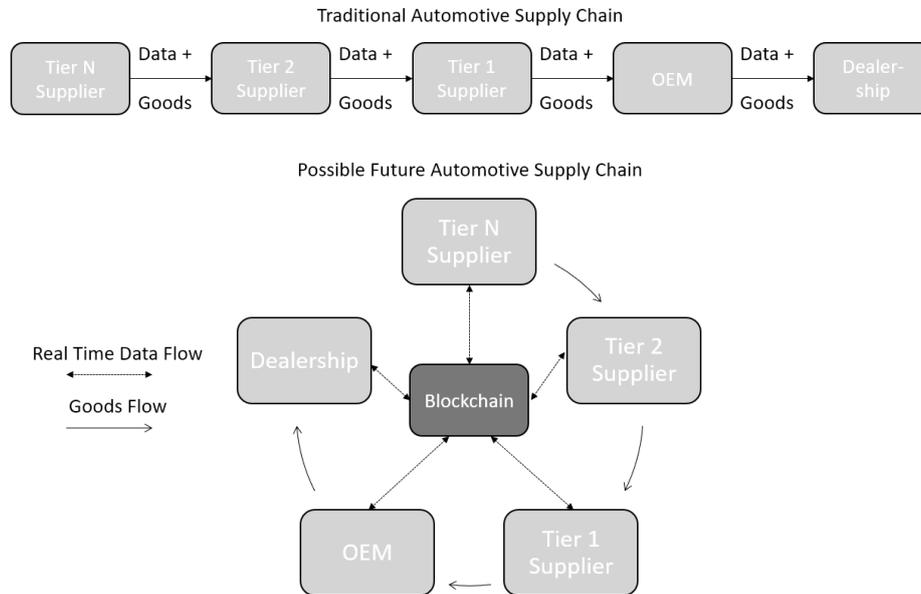
Figure 4 Traditional vs. potential future automotive supply chain (Deloitte 2017, p. 8)

3.3. Financial transactions with Crypto Currency (CC)

Crypto currency is probably the best known application of the blockchain right now. It is digital money that uses encryption techniques to generate units of currency and transaction, firstly used by Bitcoin (ZYCUS 2017, p. 4). Using the blockchain to enable a crypto currency comes with a lot of advantages, but also with some disadvantages. The most important advantages and disadvantages will be itemized. After that the transfer and application to the procurement perspective will be carried out.

3.3.1. Advantages of CC in business processes

- Decentralization: A crypto currency is not managed by a (single) bank or any other central authority. The data of the currency are distributed to every participant of its network, so there is no single authority that is able to dictate rules or execute fake transactions.
- No foreign currency: Every participant of the crypto currency is paying and making transactions with the same currency. There is no need to check for the foreign currency exchange rates. This is especially useful, if a company is dealing with a lot of foreign companies/suppliers with many different currencies.
- Anonymity: The transactions done in a crypto currency are completely anonymous, because there is no need for personalization.
- Transparency: The crypto currency is completely transparent since the data are stored in a blockchain. Every single transaction is recorded in a block, and inherent to the system the data of the block cannot be changed belated. No one else can assign this data to the holder, unless the owner publishes identity to the network.
- Transaction speed: The speed of the transaction is depending on the network of the crypto currency and how fast the data will be mined. Bitcoin for example is mining the data normally within ten minutes, which means a huge increase in transaction speed, especially if we talk about sending money abroad via bank.
- No boundaries: The use of a crypto currency is available for everyone, because it is an open currency. On the other side, it may be limited to invited participants only, if it should be required to make it private (e.g. only for a supply chain). The access is not an extensive entry barrier and is even easier than opening a bank account (Bunjaku et al. 2018, pp. 37-38 and Dumitrescu 2017, pp. 4-6).

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3.3.2. Disadvantages of CC in business processes

- <u>Volatility:</u> Since the technology is relatively new to the market and not yet widely accepted, many people are suspicious of it. Especially companies are very unlikely to deal with a form of money that has a high volatility.
- <u>Difficult to understand:</u> The technique behind a crypto currency is more complex than using a credit card for example. People are unlikely to trust in techniques they do not understand, particularly when it comes to money.
- <u>No chargeback:</u> If you accidentally sent money to the wrong account by crypto currency, you will not be able to get your money back unless the payee is willing to send it back to you.
- <u>Illegal activities:</u> One of the main advantages, the anonymity, may also be seen as a disadvantage since it can be abused by terrorists and criminals for hiding their money and buy illegal goods for example (Bunjaku et al. 2018, pp. 38-39 and Dumitrescu 2017, pp. 6-7).

3.3.3 Application and impact on procurement processes

Crypto currency could replace normal transactions by bank and accounting in the procurement application. The transactions with suppliers or clients could happen with a crypto currency that already exists, e.g. Bitcoin or Ethereum. Within a huge supply chain it could be considered to create an own crypto currency network, where every single member of the supply chain may participate. Since every single transaction is recorded in the blockchain, it is not possible to change it afterwards. This would prevent the supply chain participants trying to cheat each other. Thus distrust between the partners of transaction could be reduced. Accounting could also get unnecessary, since all data are recorded automatically. All data are always available if the private key of the company is given. Since the organization of the crypto currency is decentralized, the access is possible anywhere at any time.

To sum up, following parts in the procurement process may be influenced by introducing crypto currency into a company:

- Organization:
  - o New processes need to be introduced
  - o New qualifications or training are required
  - o New information systems have to be installed
- Management of orders:
  - o The invoicing and payment management has to be adapted
- Utilization/Supplier Development/Controlling of procurement
  - o Mining the recorded data in the blockchain for evaluation (KPI's)
  - o Availability and cost control

An example of a crypto currency transaction is illustrated in figure 5.
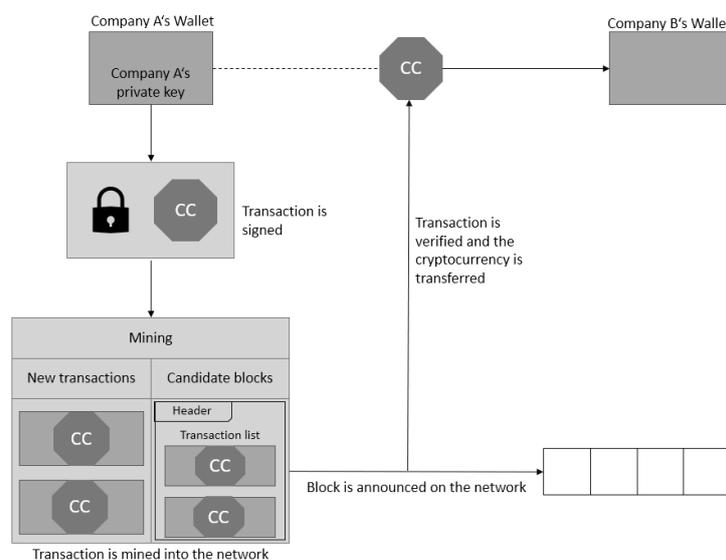
Figure 5 Exemplified transaction of cryptocurrency

4. Summary and Conclusion

In this paper blockchain application possibilities for business processes exemplified on the procurement processes are under research. Typical attributes of business processes are transactions of data, goods and money. This is why the analysis presents three of the most interesting blockchain applications for business processes. An examination of smart contracts, supply chain tracking and crypto currency in application on the procurement process developed advantages and disadvantages. In conclusion the advantages are predominant and the disadvantages can be overcome. As deployed in Figure 6 these three applications of the blockchain are directly affecting eight (phases 5 to 11) out of eleven phases (solid line) in the procurement processes. These phases deal with external partners like suppliers and customers and it is highly important to execute the respective transactions of data, goods and money and the corresponding documentation in a safe, immutable and precise way. It is not necessary to apply the block chain technology to internal phases 2, 3 and 4 (dotted lines).
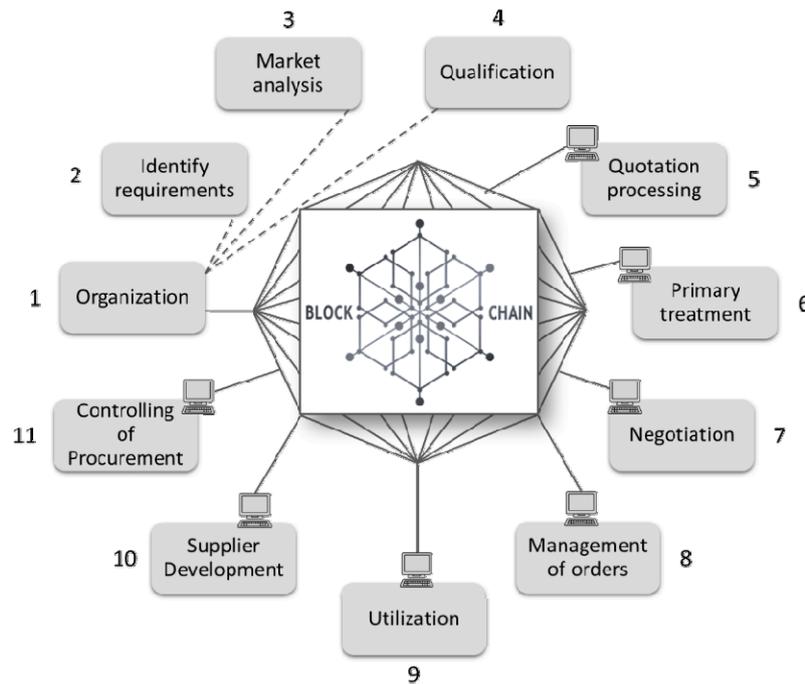
Figure 6 Overview of procurement processes affected by described applications

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