Towards a sustainable blockchain use case

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Abstract. Many blockchain applications do not survive the proof-of-concept phase. We argue that most of these application do not have a high potential business use case. As blockchain is an expensive technology to deploy and develop, it calls for disruptive use cases. These use cases should exploit the philosophy of the blockchain technology, namely (1) removal of the middleman, (2) immutable data and (3) creation of an equal network with entities who do not trust each other on beforehand.

1 Developing sustainable blockchain services

The most important promise of blockchain technology is to remove the middleman in eco-systems. This is illustrated by the Bitcoin network as the goal of Bitcoin is to handle payments between peers directly, without the need to have an intermediary such as a bank. Therefore, the Bitcoin network uses blockchain technology as a disruptive technology, as it significantly changes and impacts the eco-system for payment services by eliminating banks.

Recently, Deloitte investigated [12] the life-cycle of blockchain projects on Github, which is a very large publicly accessible repository of open source software projects. As of October 2017, there were 80,036 projects about blockchain or closely related. This seems to be a lot, but only 8% of these projects were actively maintained, and the average lifetime of blockchain projects was about 1.2 years. This implies that a very large number of projects are idle after a while, and this occurs already quite soon in the lifetime of a project.

The investigation by Deloitte does not reveal why so many blockchain projects do not survive, apart from some observations about open source projects in general. Although we have not systematically analyzed the high failure rate of blockchain projects, our own consultancy experience with blockchain projects gives us a number of indications.

Firstly, most blockchain projects are in fact proof-of-concepts (POCs). Many organizations who are threatened somehow by blockchain technology (banks, insurance companies, and other middlemen), experiment with the technology to learn the enemy. Once the technology is mastered, the POC dies and hence the corresponding project on Github becomes inactive as a result.

Secondly, most POCs are rather technology focused; often a technology driven use case is selected for which a demonstrator is build. We argue that in many cases, the use case is not sufficiently disruptive in terms of how it changes the eco-system. If the eco-system is affected by these POCs at all, it is usually about introducing an *additional* middleman, namely the company developing and offering the service at hand, now by using blockchain technology. This is in contradiction with the underlying philosophy of blockchain technology: namely to *remove* the middleman.

Lastly, blockchain is a decentralized technology by nature, which makes it an *expensive* technology as compared to e.g. centralized database technology, both in terms of development and deployment. Therefore we assume that costs are also a factor why POCS do not continue. In particular this is the case for the Bitcoin network. In a recent study, we evaluated the financial sustainability of the Bitcoin network [6]. We found that miners (the actors running the Bitcoin network) experience a negative cash flow on average. Note that individual miners may have a positive cash flow as our finding is on the industry level. This negative cash flow is caused by substantial cash-out flows for hardware and electricity power. Estimations vary, but the total required electricity power to run the Bitcoin by the end of 2017 is about 19.1 GWh/day [6] and 26.24 GWh/day (February 2017, [13, 5]). This corresponds to the energy consumption of a middle-sized EU country. Based on our estimate, this would boil down to 41 KWh per transaction [6], compared to e.g. 1.3 Wh per a traditional VISA transaction [1]. Therefore, to use blockchain in practice, a suitable *business* case must be found to compensate for the high costs associated with a decentralized infrastructure. We argue that most of such business cases, to be effective, should be disruptive for the eco-system at hand.

In this paper, we explain, based on our experience with blockchain projects, two requirements for blockchain business cases: (1) the organization structure of the organizations who need to share data (or need trusted distributed computing) should be a market structure with equal citizens, and (2) the data storage should be immutable.

2 The blockchain use case

The blockchain use cases we have seen are usually based on an already existing use case. The prototypical example here is the Bitcoin: the use case is handling payment transactions, which is already done for many years, but now without intermediate banks. Similarly, we worked on alternative currencies, which have certain properties (e.g. that you can use the coins only at registered parties). This again is a variant on traditional payment systems, but now with an added property, namely that the coin can only be transferred between parties who participate in the network.

The logical question is then: What makes a good blockchain use case? A very good, but also easy to pose criticism for each blockchain project is: Why should this use case be implemented by distributed ledger technology (DLT) at all, and not by, for example, a centralized (or even replicated) database management system? The latter is proven technology, we perfectly know how to implement it in organizations, and is cheaper than a blockchain application, both in development and certainly in deployment.

2.1 Decentralization and distribution

The key idea behind blockchain is *decentralization*, and *distribution* of, normally centralized data and processing, over a set of nodes. In terms of information technology, this means that there are no central parties needed anymore who store data (transactions in DLT) and performs computations (smart contracts in DLT), which concern *multiple stakeholders*. For example, in the traditional world, we need a *trusted* actor (e.g. a bank) that stores our data (e.g. a bank account) to allow for financial transactions to occur, between parties who do not trust each other on beforehand. This is not necessary anymore in a blockchain world; here all the stakeholders (who still do not trust each other) store their own (replicated) copy of the data, and algorithms (so-called consensus mechanisms) are in place to ensure that stakeholders can not cheat, for example by changing their local copy of the date in their own interest.

The topic of decentralization closely relates to how interactions (e.g. exchanges of economic value) between independent entities can be organized in terms of coordination and governance. This topic is well researched by various authors, e.g. [4, 14, 9–11]. In general, these entities have a *trust* problem, since they have only partially overlapping goals [8, 2], and therefore do not believe that activities are precisely performed as promised. An example is the double spending problem in the Bitcoin: If entities have their data storage, nothing prevents an entity from spending the same money twice. The Bitcoin has mechanisms in place to prevent this.

In [10, 11], three different organization structures are identified: (1) markets, (2) bureaucracies, and (3) clans. In markets, there is usually no trust between entities, as they are all equal citizens, and the one entity can not impose rules and regulation over other entities, apart from what they mutually agree. Bureaucracies often have a hierarchical nature: Some party can prescribe rules and regulations over other parties. It closely relates to the idea of a *trusted third party*: e.g. a notary service has a strict system of rules and regulations, according to which it behaves. A bank is also an example of a hierarchical entity: They are trusted because for handling payment traffic, they behave cf. rules and regulations, and also impose these on their customers. Clans can be considered as communities; loosely coupled entities, who trust each other based on shared beliefs and traditions [10, 11]. We frequently encounter clans in our ICT for development (ICT4D) projects (see e.g. [3]), where small villages want to develop a services. Which organization structure matches the best with the underlying philosophy of blockchain technology?

2.2 Blockchain market structure

We claim that a successful blockchain project should always have a market structure, and not only on the IT-level, but more importantly, on the *business model* level. Bureaucracies (or hierarchical structures) have by definition at least one a party who can impose rules and regulations, is trusted, and therefore always can deploy centralized information systems that are also trusted. Many eco-systems are actually bureaucracies with an intermediate party and hence, can not be successfully deploy blockchain technology. A centralized (and potentially) replicated database is simply a more cost effective solution. Therefore, to apply blockchain technology meaningfully in bureaucracies, it should be transformed into markets, where each entity is an equal citizen in terms of rules and regulations. This implies removal, or at least a change of role, of the intermediate parties. We argue therefore that motivations for a good blockchain use case should not be sought into technical arguments, but in changes into the eco-system (e.g. removal of the middleman). These changes can be modeled and analyzed with modern business development tools, such as e^3*value* [7]. Moreover, developing such a new eco-system and its corresponding business models requires all stakeholders involved, plus the willingness of intermediate parties to leave their powerful positions. Finally, because there is not really the issue of distrust in clans, they are not very suitable for blockchain technology either. However, in the ICT4D projects we currently are doing, there is a need for coordination *between* clans. This boils down to a market structure again.

2.3 Immutable data

There is one other important idea behind the blockchain technology and that is that each record (effectively tuples with data) is *immutable*. Blockchain represents data as a chain of (historical) transactions. It is computationally not feasible to change earlier transactions once they are submitted. This property is amongst others the basis for solving the double spending problem. In contrast, traditional databases do not store the full history of data but only the current world state. Therefore, if the requirement is to have immutable data storage, blockchain technology is a candidate technology to consider.

3 Conclusion

In this paper, we have argued that there are at least two important requirements that need to be in place in order to develop a successful blockchain application. First, there should be multiple entities, who do not trust each other. Moreover, this entities should be organized as a market, meaning that they ideally are all equal citizens. Second, there should be a need for immutable data storage. Blockchain solves this by only allowing to add data in a chain (hence the name), not to change or to remove it.

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