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Abstract

The Blockchain has evoked the interests of researchers and practitioners alike. Market studies predict that it has huge potential to disrupt existing economic structures and business processes, yet the complex technology behind it makes it hard for many people to grasp the basic functionality. Lacking are easy-to-use interfaces and playful applications which would allow for a simple Blockchain exploration. The project Play4Privacy (P4P) used the ancient Chinese board game Go to increase public understanding of the Blockchain. Individuals could join teams to jointly determine the moves of the stones, and tokens could be mined while playing the game. The respective moves of the stones were displayed on the wall of a public building. In this case study we use six qualitative interviews to summarize the anticipated and unanticipated findings of the project, which was not only intended to increase public awareness concerning Blockchain technology, but also toward privacy on the Internet. The results of this research project reveal several important managerial and behavioral obstacles that have to be overcome in order for Blockchain technology to reach widespread adoption.

Keywords: Blockchain, Gamification, Games, Innovation Diffusion

1 Introduction

Blockchain technology is seen as one of the most important and disruptive technologies in the years to come (Holden and Moar, 2017; IBM 2017). Treiblmaier (2017, p. 6) defines it as a "digital, decentralized and distributed ledger in which transactions are logged and added in chronological order thus creating permanent and tamper-proof records". In contrast to traditional cloud-based and server-based applications, the storage of transactions is decentralized, which makes it increasingly hard to alter previous transactions as the chain gets longer. The basic principles of Blockchain in the context of digital money were published by Nakamoto (2008), a pseudonym used by a single person or a group of researchers whose true identity has not yet been uncovered. In this seminal paper Nakamoto proposes a workable solution for the so-called double spending problem, which occurs when the same digital token can be spent more than once. In 2009 the first functioning client of Bitcoin was released. Adoption of the new technology was slow at first, which can be attributed to the complexity of the technology as well as its unclear potential. In the case of Bitcoin it was the year 2013 when the currency finally started to take off. Current predictions regarding the future of Bitcoin range from its collapse[1] (Futurism, 2017) to a value of $500,000 in 2020 (Cryptocoins News, 2017)[2].

In the wake of Bitcoin, its underlying technology, Blockchain, has attracted researchers' interest and new ideas have arisen on how to use Blockchain as a more generic technological platform on which different kinds of contracts can be deployed. Among others, Ethereum was developed as such a platform that includes a virtual machine which is Turing complete and functionally different from Bitcoin (de Ridder et al, 2017). Ethereum thus allows for the deployment of so-called smart contracts which were envisioned by Nick Szabo back in 1996. Smart contracts embed contractual clauses (e.g., liens, bonding, delineation of property rights) in the software and hardware such that a breach of contract turns out to be extremely complicated or expensive for the infringer (Szabo, 1996). The use of platforms such as Ethereum allows for the storage of byte code on the Blockchain, which is executed by a virtual machine running on every node. After deployment the code cannot be altered, which helps to decrease transaction costs, but also bears significant risks in case software bugs exist.

Blockchain technology is based on sophisticated cryptography as well as digital signatures to prove ownership of addresses and initiate transactions, and is still in an early stage of diffusion[3]. Direct interaction with the Ethereum blockchain, for example, demands some basic understanding of its underlying functionality. Application software such as wallets (e.g., Ethereum wallet), browsers (Mist) and plug-ins (e.g., Metamask) exist to facilitate the interaction with the Ethereum blockchain, yet the technology has not gained widespread acceptance among the general public yet and the range of potential future applications is hard to predict (Chartered Accountants, 2017). Previous research has summarized potential applications of the Blockchain (e.g., Yli-Huumo et al., 2016; Conoscenti et al., 2016), but rigorous academic studies are missing that quantify the current level of "Blockchain literacy" among managers and the general public, as are solutions, in the tradition of action research (Davison et al. 2004), on how to overcome this knowledge gap. Given that the Blockchain is expected to significantly impact our private and professional future lives (Swan, 2005), it is crucial to better understand the potential implications of this technology. In this paper we therefore present the results of an exploratory case study that strived to familiarize a general audience with Blockchain technology. In this project a gamified user experience, namely the opportunity to play the game "Go" on a huge

[1] This claim was made by Kenneth Rogoff, Professor of Economics and Public Policy at Harvard University. However, he did not specify when exactly this is going to happen.

[2] This estimate was made by John McAfee, cybersecurity and software pioneer. Several twitter posts exist in which he predicts an even higher increase in value.

[3] The Gartner Hype Cycle for Emerging Technologies 2017 shows Blockchain as having exceeded the "peak of inflated expectations" and now reaching the "trough of disillusionment" (Gartner, 2017). The greatly varying market predictions concerning Blockchain's future, however, illustrate the difficulty in making predictions regarding this technology and its potential applications as well as risks. The relative novelty of Blockchain paired with its overall complexity still causes many misunderstandings and myths among industries, governments, and even more among the general public (Pisa and Juden, 2017).

public wall while staying anonymously, was used to attract a general audience to try out Blockchain technology.

In total, we came up with two research questions:

R1: How successful was the project in raising awareness about the Blockchain?

R2: What specific lessons were learned that can benefit similar projects in the future?

We first briefly provide an overview of current work including existing theories of technology diffusion. Next, we present the case study and discuss the underlying rationale of our project. The results from six qualitative in-depth interviews are used to assess the anticipated and actual implications of the project. The findings highlight the various expected and unexpected results that occurred during the execution of the project. Finally, we discuss implications for researchers and practitioners and present several conclusions of our research.

2 Related Work

Currently, a dearth of Blockchain-related research exists in the IS community. However, there are strong indications for the growing popularity of the topic in the near future, such as a steadily increasing number of conference publications (e.g., Beck et al. 2016, Glaser 2017) and dedicated workshops, as well as calls for papers in prestigious academic journals (e.g., JAIS, BISE). The IS community is well-suited to undertake Blockchain research, since it entails the design of innovative technological systems as well as the investigation of the expected impact on a huge number of industries and, finally, its implications for humanity. The IS community thus has the necessary repository of theories to explore, explain and predict Blockchain-related phenomena (Gregor, 2006) as well as the tools to create new solutions (Hevner et al., 2004).

Plenty of literature exists regarding the diffusion of (technological) innovations and its manifold influencing factors (Rogers, 1962; Moore and Benbasat, 1991). Several studies have explicitly investigated the diffusion of games (Cheng et al., 2004; Wang and Goh, 2017) as well as the impact of various extrinsic and intrinsic motivators of technology acceptance and, more specifically, how they can be applied in a gamified context (Altin Gummussoy, 2016; Hamari and Koivisto, 2015, Putz and Treiblmaier, 2018). Appealing to humans' innate predisposition to play has been shown to be an effective way for increasing motivation and interest in a particular subject (Huizinga, 1967). In this case study we thus build on previous literature and explore how gamification elements can be used to get individuals involved in Blockchain technology and how to create a positive attitude toward using it further in the future.

3 Method and Data Collection

We used a holistic (i.e., single unit of analysis) and single-case design (Yin, 2013). The focus of this project was on motivating individuals to actively try out Blockchain technology by creating tokens in a gamified way that can later be reused on other platforms in various contexts. The role of the researchers included both observation and active participation, which was necessary to counter unintended side effects. Following the principles of the cyclical process model and the tenets of canonical action research (Davison et al. 2004), the project included various steps of action planning, intervention, evaluation, reflection and diagnosis. Data about participation in the game was gained during all the phases of play. This did not include, however, the gathering of any personally identifying information. Since anonymous Blockchain technology was used to record every single move that transpired, it was neither intended nor possible to collect personal data of the players. After completion of the game, qualitative interviews were conducted with three members of the development and management team (i.e., project leader, project manager, marketing & communication manager) as well as three interviews with players, who agreed to participate in the study and to share their experiences. The three players were junior and senior researchers at a private university in Austria who agreed to try out the game and to provide detailed feedback. One of the players had substantial prior experience with the Blockchain, while two considered themselves to be novices. The

interviews were narrative in nature and we started with asking the respondents to tell us about their experience with the game.

All interviews were transcribed and analyzed following guidelines for qualitative data analysis. Based on the transcripts, two researchers built categories following the tenets of qualitative content analysis (Mayring, 2014). Exemplary statements for the respective categories are presented in the results section of this paper. We used a positivist analysis approach, which included the identification of nonrandom variables in the context of content analysis. The researchers were not involved in the project and results were double-checked in order to ensure validity.

4 Case Discussion and Findings

4.1 Play for Privacy

The goal of the project Play for Privacy (P4P), which was conceived and realized by the Austrian Blockchain incubator lab10 collective, was to familiarize end users with Blockchain technology. A variable supply of tokens, called PLAY (symbol: PLY), was created and half of them were distributed to the players that decided about the moves in the game (proof of play). It was up to the players to decide whether they wanted to keep their tokens or to donate them to the lab 10 collective after the end of the respective game. Additionally, it was possible to receive PLAY tokens from the mined pool by donating money (Schreiber 2017). Smart contracts based on the Ethereum platform were used to generate tokens during the process of playing. Every proposed move resulted in the creation of two tokens. Proposed moves were further cryptographically signed by the client browser application and included in a *game state* object composed for every game by the server. This game state objects were then published on IPFS and their hashes persisted on the Blockchain, allowing detailed verification of all games in a cost effective way (Hofer, 2017). A total of about 400,000 tokens was generated during the game, and another 400,000 were divided among the donors.

Rather than relying on an energy-intensive proof of work algorithm that is based on the hash power of the participating miners, a proof of play algorithm was used. Tokens were therefore given to those players who actively participated in the game and executed a particular move. All players received a token, independent of whether it turned out to be the "winning move", which was selected by a majority decision, or if their team finally won the game. In addition to every token being *mined* by users, one token was created and stored in a pool to be given to the donors supporting privacy initiatives. The project was launched in February 2017 with the team formation and start of software development. In August 2017 the product was completed and was officially launched on September 27. In October 2017, PLAY was listed on a P2P exchange. As planned, mining was stopped on October 27 and the final amount of tokens could be claimed until the end of the month (lab10 collective, 2017).

The game was shown live on the facade of the Kunsthaus Graz (Figure 1). The Kunsthaus is a museum of contemporary art that has an acrylic glass screen which can be used for artistic productions. A total of 930 fluorescent rings, each 40 Watt, are embedded in the outer skin of 900 square meters. The illumination level of each ring can be varied continuously (Januszkiewicz and Paszkowska 2015). On the right side of Figure 1 a screenshot of the game Go is shown. The game was played on a 9x9 board. The goal of this ancient Chinese game, which is usually played by two different persons, is to surround more territory, as represented by the fields on the board, than the opponent. A detailed description of the game can be round of the web site of the American Go Association: http://www.usgo.org/what-go.

In the case of Play 4 Privacy, participants were allocated to one of two competing teams, with all the players participating online without revealing their true identity. Each player decided on the next move individually, and the final decision was made by a majority decision. The game was played for four consecutive weeks in the late afternoon with 30 to 50 participants in each of the two groups. The number of players remained fairly stable during the whole period.

Figure 1. The Kunsthaus Graz (left) and the game of Go being played on the facade (right)(CS, 2017, PBS, 2017)

4.2 Results

Figure 2 shows the main categories which emerged in the process of coding and conceptualizing the statements from the development team and end users respectively. The goals for the development team included the familiarization of the general public with Blockchain technology, while at the same time creating awareness for privacy issues on the Internet. During the execution phase of the game, which lasted for roughly one month, several intended and unintended side effects emerged. The latter included the lack of participation of inexperienced users, sybil attacks as well as the misuse of the application for drawing patterns rather than for gaming purposes. In total, the project resulted in several successes as well as problems which led to several lessons learned and concrete plans for future Blockchain-related projects. On the side of the end users, usability was a major issue. Our interview partners talked intensively about their gamification experience and detailed how they would like to use Blockchain technology in the future. We will elaborate on these categories in more detail in the following sections.

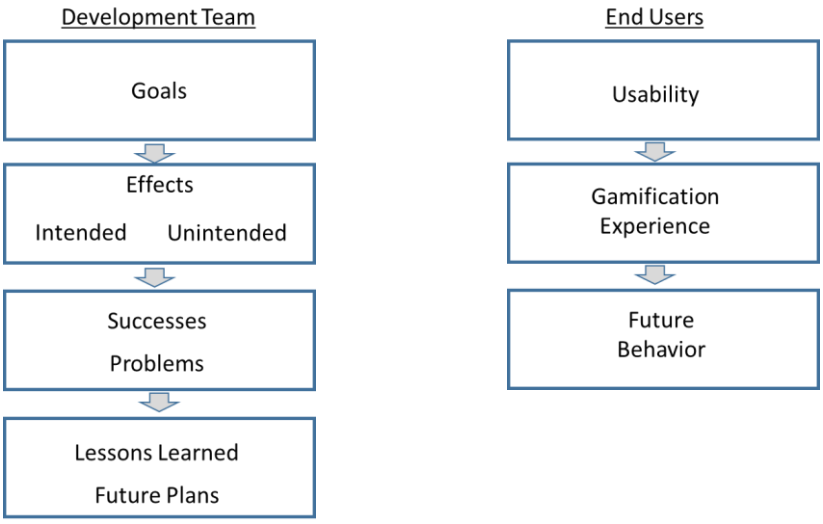

Figure 2. Main categories in the gamified Blockchain study

From the perspective of the development team, there were several *goals* of the Play4Privacy project, some of which emerged during the design phase. The core team differentiated between goals that pertained to creating awareness for Blockchain technology and others that related to promoting the

issues of privacy. The players should understand that participation in the game and even the receipt of tokens, which can be reused later, did not necessitate the disclosure of any personally identifiable information. Sample statements included:

- *… we have two goals … we want to support privacy organizations … promoting privacy … but also promoting Blockchain …*
- *… users should be anonymous… this is the purpose of this game …*
- *… we do not want to collect personal data*
- *… the token could later be used for various purposes …e.g., on a platform that also accepts PLAY tokens …*
- *The game is a good metaphor for the Blockchain … everyone can see how the game goes and which moves are made… but participation is anonymous … nobody knows who you are …*

The game led to several *intended effects* that were envisaged in the original project design. For example, money was raised for privacy initiatives, users learned about the functioning of the game Go and, most importantly, about Blockchain technology:

- *… regarding privacy I am happy to say that we have established good connections with epicenter.works and that we were able to collect donations for them …*
- *… users had an option to learn Go by seeing what moves get a majority vote…*
- *… we make it clear that every payment for our token is a donation for privacy … we communicated this clearly … our token is not for speculation purposes …*
- *… those users who downloaded their tokens clearly understand the functioning of the system…*

However, during the running time of the game, several *unintended effects* emerged. The development team, which constantly monitored the game and participated in it themselves, was able to mitigate some of the issues during the course of play. In other cases they simply had to acknowledge that things developed in a different direction than expected. Examples of the former include unwanted drawings on the facade and scripted sybil attacks (individuals impersonating multiple player identities at the same time), while lack of interest in or understanding of token usage or failure to reach the target community illustrate the later:

- *… some people tried to find a majority … in order to control the game and make drawings on the facade …*
- *… users who do not have experience with cryptographic systems all tended to donate their tokens … many users apparently did not understand that they got something of value … a digital good …*
- *… a community emerged … but we suspect that most of them were already knowledgeable regarding cryptography … so we did not reach the general audience …*
- *… we know that we did not reach the general public, since we talked to people from the cryptography community which we know, and many of them participated … of course, we do not know for sure … but we also saw it in forums …*

In several aspects the project was *successful*. This included the amount of money raised for donations and the positive feedback from users, some of whom mentioned their playful experience. This project was one of the first to introduce "proof of play" as a consensus mechanism and as a potential protection against sybil attacks and also created some awareness for the Blockchain. However, at the same time several *problems* emerged, which mainly included the difficulty of reaching a general audience that had no prior experience with the Blockchain in general:

- *… as far as donations are concerned, I am quite satisfied …*
- *… different consensus mechanisms other than proof of work have a huge potential…*

- *... we succeeded in creating a playful way to familiarize users with this complex technology ...*

- *... we did not fully reach the non-crypto community ...maybe it was too complex ...*
- *... we had a good start ... then we even found a bot that sabotaged the game ...*
- *... we did not succeed in reaching people who did not have any prior experience with cryptography... we were not able to reach them with our message ....*

Upon completion of the project, the development team reflected about the processes and identified various *lessons learned* and *plans for the future*. Those included modifications of the gaming process, the marketing procedures and future applications of the technology:

- *... the basic idea was great ... the experiment worked ... but not fully in the direction that we anticipated ...*
- *... as far as the game is concerned, we have quite a few lessons learned, which could be improved ... for example, those Sybil attacks where people draw on the surface ... one should have an option to stop that ... one solution would be that every move of every player is evaluated ...*
- *... there were opportunities for attacks ... people were abusing it ... we anticipated it ... it took a couple of days for the users to find this out ...*
- *... we need more promoters ... we were present in specific media but did not reach out to other communities ...*
- *... now we have a well-developed product which is ideally suited for future applications...*

From the perspective of end users, *usability* of the system was key for a joyful experience. Especially the more inexperienced users encountered some difficulties at first:

- *... at first it seemed confusing, but then I found it easy to use...*
- *... my moves were frequently overruled by other players, but I have to admit that I do not know much about GO...*
- *... the interface was easy to use ... once you fully understood it ...*
- *... interaction with the system was easy ... but I did not fully understand what was going on in the background ...*

The *gamification experience* especially appealed to our interview partners. They stressed the fact that they liked the setting of the game and that the game was shown publicly. However, they also criticized that they lacked control of the actual game:

- *... it was fun to play an online game that is shown in the real world ...*
- *... it was fun to see how one's moves were shown on a big screen ...*
- *... now I have a much better understanding of the Blockchain ... and it was a fun experience ...*

Finally, the interviewees commented about their intended *future behavior*. Especially the players who did not have any prior Blockchain experience stated that they would like to learn more about it in the future. Additionally, the gamification element helped to spark some initial interest:

- *... for me it was all about the game ... I did not know much about Blockchain before, but it seems quite interesting to me ... I would like to get more involved in the future ...*
- *... I am curious to learn how I can use my PLAY tokens in the future ...*
- *... this was a very helpful introduction to Blockchain technology ... I will definitely have a look at other initiatives in the future ...*

5 Managerial and Academic Implications

At present, Blockchain technology is a hyped topic, but the implications for industry and society are unclear (Hackett, 2017). Yet, the projected implications are substantial and are expected to span a wide array of industries and technologies, including finance, accounting, energy, supply chain management, tourism and healthcare (Mathieson, 2017; Önder and Treiblmaier, forthcoming). Additionally, implications for organizational structures and society as a whole are predicted (Treiblmaier, 2017). Notwithstanding the disruptive potential and the implied opportunities and threats, many companies are still struggling to better understand how the Blockchain might potentially affect their business models. Furthermore, the general understanding and acceptance of Blockchain-based solutions in the general public is still in an infant stage. In order for Blockchain-based solutions to get more widespread adoption, it is thus crucial that a general awareness regarding the potentials of this technology is raised. The preliminary findings from our case study provide some indications on how to design applications that can raise public interest in the technology.

A solid theoretical underpinning of Blockchain technology in the IS community is still missing, but our preliminary results highlight the need of investigating various antecedents of technology adoption and the implications thereof. Additionally, theories from new institutional economics (NIE) such as transaction costs theory (Treiblmaier and Strebinger, 2008; Liang and Huang, 1998) and principle agent theory (Sikora and Shaw, 1998; Hann and Weber, 1996) will be valuable to explore the broader economic impact. Dynamic theories and theories investigating organizational performance, such as the resource based view of the firm (RBV) (Mata et al., 1995; Santhanam and Hartono, 2003), and contingency theory (Weill and Olson, 1989) can be helpful to better understand companies' opportunities to create competitive advantage by using Blockchain technology.

6 Conclusion and Future Research

In this paper we present the preliminary results from a case study conducted in Austria in which the Chinese game Go was used to introduce end users to the basic operating principles of Blockchain technology. We especially investigated the questions on how awareness for the Blockchain can be raised and how this experience was perceived by the development team and end users. This gamified approach was based on "proof of play" as a consensus mechanism and the generated tokens are still available for further use on the Ethereum Blockchain. Feedback from several project participants as well as participation numbers showed that this project was well received and presents a first step toward introducing Blockchain solutions to the public in a gamified way.

In spite of the huge media attention the Blockchain is getting at the moment, the implementation of actual solutions on a widespread basis is still in a preliminary stage and the full range of potential future applications is largely unknown (White 2017). Given the complexity of the underlying technology, easy-to-use interfaces are needed. In this research we have shown (a) that gamification is a viable instrument to familiarize users with Blockchain technology, (b) proof of play can be used in certain settings as a consensus mechanism, and (c) the widespread adoption of Blockchain technology is contingent on creating secure and user-friendly solutions. More theoretical research is needed to better understand, explain and predict the possible implications of Blockchain technology as well its impact on humans. Additionally, design science and action research can make important contributions in designing and implementing solutions that provide value for businesses and humans alike.

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