BLOCKCHAIN: A PROOF OF TRUST

master thesis
strategic product design
sebastián manrique

10-10-2018

TU Delft Cognizant

“Tell me and I will forget,show me and I may remember; involve me and I will understand.”

- Confucius

DESIGNING FOR TRUST IN BLOCKCHAIN TECHNOLOGY

AUTHOR

Sebastián Manrique
sebastian.manrique.1993@gmail.com

MASTER THESIS

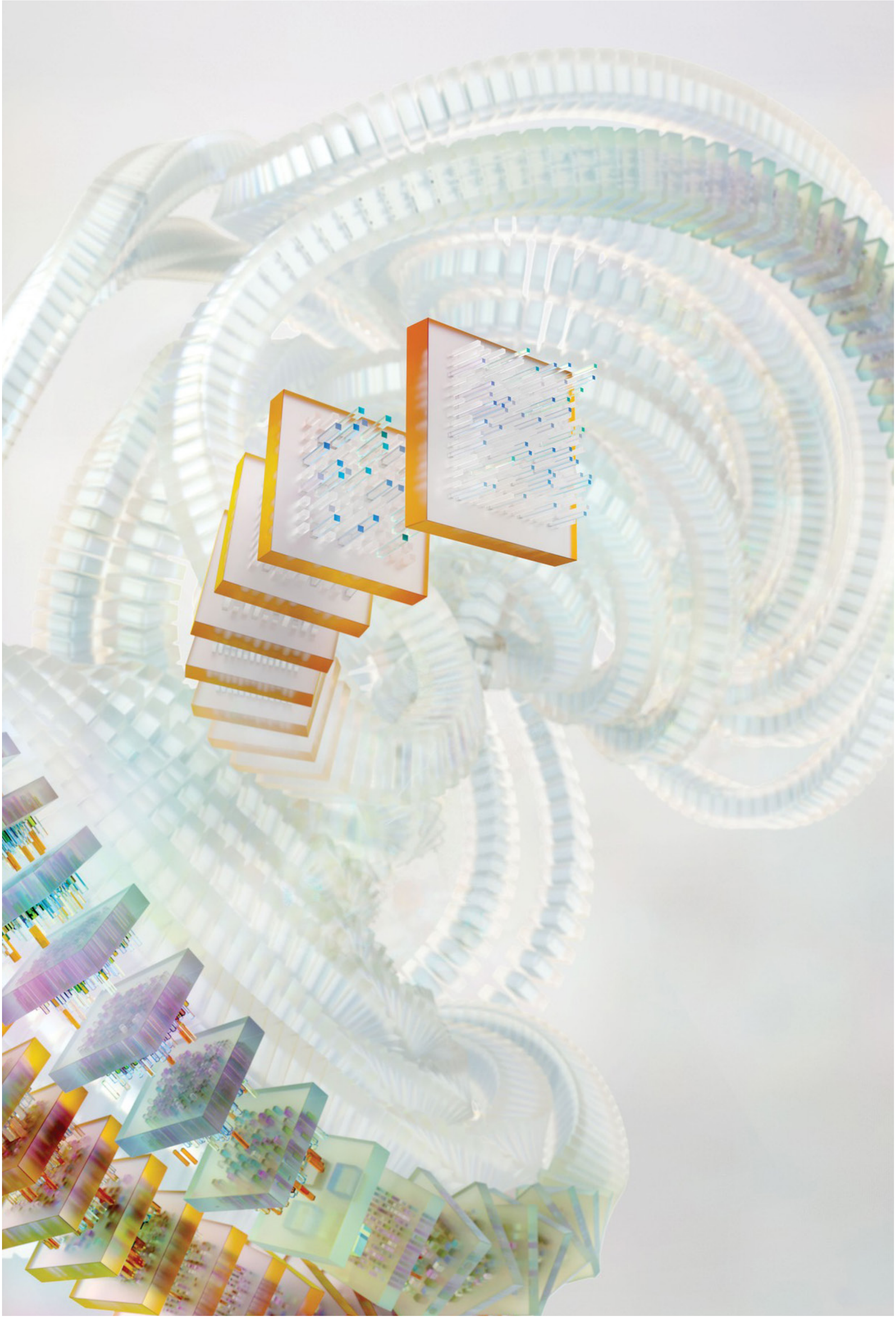
MSc. Strategic Product Design
Faculty of Industrial Design Engineering
Delft University of Technology

SUPERVISORS

Chair – Dr. G. Calabretta
Faculty of Industrial Design – Product Innovation Management

Mentor – Prof. ir. J. van Erp
Faculty of Industrial Design – Conceptualization and Communication

Company mentor – Tim Smeets
Digital Strategist at Cognizant



Preface

In front of you is my graduation report for the master Strategic Product Design at the Delft University of Technology. The report is a result of an 8 month project done in collaboration with the great digital consultants of Cognizant.

For the past half year my brain has been wired to react instantly to the word ‘trust’. Wherever and whenever I heard it, my heart rate increased slightly and my focus would be redirected instantly to the place of origin. I learned many things about this psychological concept and the project would often take me into philosopical directions. Although blockchain and trust can be way to fuzzy, I hopefully succeeded in bringing it down to some practical insights for business as well.

I could definitively not have done this alone and would like to thank my mentors that surrounded me during this project.

Jeroen, thanks for always coming with an option beyond my imagination and hinting at directions for the project that I hadn’t thought of. Your creative analogies and metaphors inspired me to look at things beyond the cold facts.

Giulia, thank you for keeping me focused and getting my story straight. Thanks for telling me to stop reading papers and start converging, otherwise I would still be reading papers now.

Tim, thank you for giving me all the freedom to execute this project within Cognizant. I enjoyed your project management guidance and asking the necessary questions of what has been done and what needs to be done when I was floating around. Thanks for allowing me into Cognizant’s casestudy team and having a lot of fun along the way!

Also, I could not have completed this project without the help of friends and Cognizant’s experts for the creative sessions and multiple game testings.

Finally I would like to thank my family and friends for taking the time to listen to my ideas. Specifically want to thank Stijn and my parents for reading the whole report.

I also want to thank my wife, Tanna, for helping me through the mental struggles of this project and making me think straight when I wasn’t sure where to go.

I hope you enjoy reading this report and especially discover some interesting insights!

All the best,

Sebastian Manrique

« Previous page
“One day of Ethereum blockchain transactions”
by FIELD (www.field.io)

Executive summary

This report explores the topic of 'designing for trust in blockchain solutions' as part of the technology's adoption by clients of Cognizant. The result is a game that provides clients with a first insight into the new form of trust relationships that blockchain brings.

In recent years blockchain has gotten attention from public, business and politics. It is said to decentralize the exchange of value, similar to what the internet did for information. For this blockchain addresses the key topic of trust. In the past decades trust has evolved from local to institutional to partly decentralized. Blockchain takes this further and assumes distrust among peers and enforces exchanges through hard code. Instead of having to trust a peer or a third party, people can trust the veracity of the process. Although proclaimed to be trustless, trust still needs to be placed in the technology itself. The goal of this project was to design an experience that allows people to build (initial) trust in blockchain technology. Understanding the role of trust in a blockchain ecosystem was achieved through a literature study on trust in technology, a decomposition of blockchain and a case study of one of Cognizant's blockchain projects for a multinational shoe retailer on inventory sharing.

From a theoretical perspective results show that trust still plays a role in blockchain ecosystems: A lack of computer literacy prohibits people from understanding the open source algorithm code. Governance of a blockchain protocol can be fuzzy, making individuals unable to control changes. Blockchain propositions often include human interaction or physical products which cannot be affected by a blockchain system. Data that is fed into a blockchain system cannot be checked for correctness by a blockchain system, thus providers of this data still need to be trusted. Transfers done on a blockchain cannot be undone placing a heavy weight on someone's personal trust (self-confidence). If a crypocurrency is used, participants need to trust that it will maintain its' value.

Another key challenge is nudging trust towards a justified trustee. Blockchain appears to bring forth a new form of trust that is not peer-to-peer nor institutional. Rather, trust has to be placed in a collection of components (code, cryptography and protocol) that is controlled by an algorithm and collective group. It will take time for people to adopt this new form of trust as social norms need to (be) developed.

Results from the case study show that adopting blockchain technology is not only a technical or business feat but also an emotional and social endeavour. Setting up a blockchain ecosystem forces the initiating company to engage with competitors in a more direct way and seems to feel like they have to open up. It creates interactions that companies might be uncomfortable with as it often concerns sensitive data. Next to this, it seemed hard to really grasp or experience the value of blockchain technology which can be a barrier when designing with it. Clients also appeared to approach the technology using 'old' trust concepts, which might result in missing out on the technology's real potential. Finally, the major

Cognizant could play a key role in making clients comfortable with this new form of interaction by offering direct experiences with blockchain rather than only knowledge transfer. Also acknowledging the emotional/strategic challenge of cooperating with competitors more closely is something where Cognizant should build activities around. Eventually the company could position itself as an 'ecosystem builder', providing support to not only the client but also the partners in shaping the ecosystem and relationships.

To support this role, an interactive game called 'Viral Art' was created that provides clients with an initial experience of the new form of trust and 'coopetition' that blockchain brings. Experiences from the game can lead into a discussion on the impact on a clients' own business network and shape the further activities of a project. In the game participants simulate a digital museum and compete for the most valuable (unique) art through trades. Throughout the game players go through all three different forms of trust.

A final evaluation with Cognizant led to recommendations for further development including digitization, stronger facilitation and the extension to a workshop format.

Reading guide

01 Project background and assignment
Definition of the problem statement and assignment with background and context.

02 Trust in technology
Understanding how trust interactions work and how it relates to technology.

03 Decomposing blockchain technology
Analysis of blockchain technology's components which impact trust.

04 Understanding blockchain's trust paradox
Combining trust literature to blockchain insights to understand a new form of trust.

05 Blockchain through the eyes of clients
Extensive case study on blockchain trust challenges in practice.

06 The design brief
Crafting a design brief focused on 'making people experience blockchain'.

07 Experiencing new technology
Analysis and case study on what it means to experience a new technology.

08 Viral Art blockchain board game
Exploring a game that allows clients to experience the new trust of blockchain.

09 Evaluation and recommendations
Learning from the final game test and providing future recommendations.

10 Conclusion and reflection
Analysis of blockchain technology's components which impact trust.

OVERVIEW

On the left you will find a schematic representation of the activities that were undertaken for this thesis project. Each chapter will start with an introduction after which the performed research and activities will be elaborated on. At the end of each chapter is an overview of the key insights. for both the project as well as Cognizant. These insights form the basis for the design direction, ideation and final recommendations.

In the left margin the references and explanations of tools and methods are shown. A complete overview of all the references can be found in the back. Appendices will be attached at the end of this report.

Names of the people and companies related to the case study have been anonymized in order to maintain privacy.

KEY TERMS

BoH	Back Of house
FoH	Front Of house
OOS	Out Of stock
POS	Point Of Sale
SB	Shoe Brand
SIM	Store Inventory Management
WS	Wholesaler(s)
DLT	Distributed Ledger Technology
POC	Proof Of Concept
POT	Proof Of Technology

Table of contents

Introduction

This project brings together the topics of trust and blockchain technology. Trust, a multidimensional construct, that has been heavily researched in domains ranging from psychology to neurology to economy. For hundreds of years it has acted as the accelerator in our daily interactions but it's seeing a shift in the way we as humans value and experience it.
Blockchain, on the other hand, is a technology that directly confronts anyone interested with terms such as 'crypto-economics', 'hash functions', 'miners' and proclaims to transform our world into one that is trustless and operates 'decentralized', again. It could potentially slash the price of trust to a fraction of what we are currently used to. However, as it is still in its infancy, no one really knows what will become of it, if anything even. Nevertheless, the key questions that started of this project is: will we even trust a blockchain? Why should we?

chapter 1

Project background and assignment

In this chapter an introduction will be given to the key topics and how they relate to each other. First some background information on Cognizant, then on trust in technology and blockchain. After this the problem and assignment definition will be described. The chapter concludes with the design approach that was used for this design project.

PROJECT BACKGROUND

Cognizant

Cognizant is a multinational professional service consultancy with about 260.000 employees[1], focused at helping clients "envision, build and run"[2] digital innovations and businesses. Although originated and mainly established in India, it has its' headquarters in Teaneck, New Jersey in the United States. In the Netherlands, the company has two locations: a Dutch headquarter and a newly opened digital studio, both in Amsterdam. Cognizant's three main service pillars are: Digital Business, Digital Operations and Digital Systems & Technology. These services cover a broad range of activities from defining new digital innovations to completing full operational implementations to changing organizations' ways of working (e.g. automation). To further widen and deepen Cognizant's capabilities, the company buys other agencies. Examples include Mirabeau, Idea Couture and recently the Belgian Hedera. This thesis concerns a project which was initiated by the Digital Business branch.

Cognizant Digital Business helps clients in different industries envision innovative services and transform companies' current products, services and business models often using upcoming digital technological opportunities. The branch offers multiple distinct services (see Figure 1) but project teams often involve employees from different disciplines (e.g. user experience designer, technology experts, visual designers, business consultants and other experts). The digital business consultants often execute projects for clients that want to explore the possibilities and opportunities of new technologies such as the Internet of Things, Artificial Intelligence and the Blockchain technology. The latter is the focus technology for this specific thesis report.

Cognizant has strong developing capabilities in India which makes it possible for the company to take on bigger projects which move from conceptualization to either proof of concepts or full development. Key clients come from healthcare, banking and finance, telecom and retail.

One of the goals of this report is to *extend the*

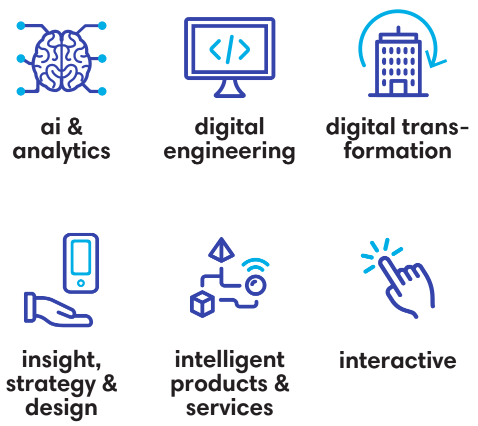


Figure 1: Main services of the Digital Business unit

1. Cognizant. "2016 Annual Report – Helping Clients Build and Run Digital Business." *Cognizant*. 2017. https://www.cognizant.com/content/dam/cognizant_foundation/investors/2016/annual-report.pdf

2. Cognizant. "Driving Digital Change." *Cognizant*. https://www.cognizant.com/nl-nl/drivingdigital-change

knowledge of Cognizant on designing for certain experiences when dealing with technology heavy projects, in this case the experience of trust.

Trust developments

With anything new, be it an innovation, technology or new acquaintance, it is often ones' trust that determines whether an interaction is continued. People step into an airplane because they trust that a pilot will bring them to their destination safely. On the other side, a lack of trust is also one of the reasons why innovations are not continued. People still carry paper passports and vote with a red pencil on a paper sheet (in the Netherlands), even though new and theoretically better ways of doing these activities already exist. Trust is seen as a “pivotal factor in determining how we progress as a society”[3], it allows us to get used to doing new things which keeps moving us forward. From the perspective of transacting with one another and the creation of value, trust is what “enables people to do business with each other”[4]. It seems that trust is an important ingredient for society to function. However, it has been and is changing.

Until the 1800s, trust emerged through close relationships on a local scale, during the 19th century large companies emerged which didn't

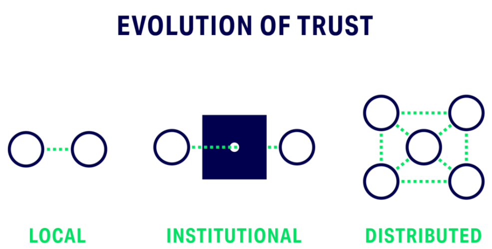


Figure 2: Evolution of trust. Rachel Botsman

know people as individuals and humans started to trust in “black box systems of authority”[5] and less directly in other people. However, in the past years this so-called ‘institutional trust' has been on a decline. It is not hard to think of major breaches of trust by large institutions that may have contributed to this: Facebook's Cambridge Analytica scandal around the misuse of personal information for political influence[6], the Volkswagen ‘dieselgate' where emissions where purposively tweaked during emission tests to meet US standards[7] and even the exposure of sexual abuse in Catholic churches[8] can be seen as an example. In the past years, the annual ‘Edelman Trust Barometer' has shown that trust in organizations, governments and institutions by the general public has been on a decline to a point of “stagnant distrust”[9] where 20 out of 28 interviewed markets (see figure 3) are deemed

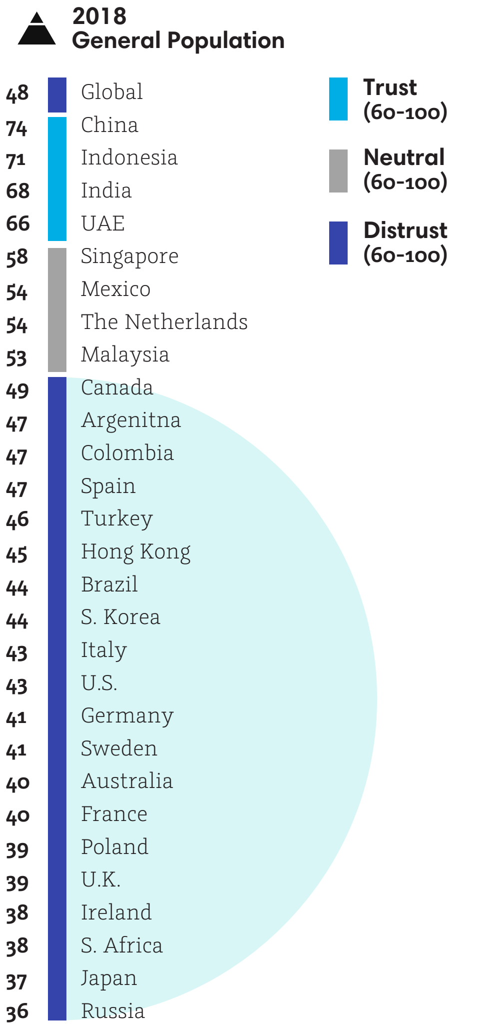


Figure 3: Average trust in institutions by general population for 2018. Adapted from Edelman.

‘distrusters'. Rachel Botsman, a well-known expert in the field of trust says “institutional trust wasn't designed for the digital age”[10] indicating that it is time for a new trust ‘paradigm'. Botsman states that ‘distributed trust' will be the next way in which trust is established in our society, see figure 2. Distributed trust is about stepping away from third parties and collaboratively building trust in a peer-to-peer community.

With platforms like Airbnb people trust sleeping in the houses of total strangers based on a reputation

3. Diekhöner, P. K. *The Trust Economy: Building strong networks and realizing exponential value in the digital age.* Marshall Cavendish International Asia Pte Ltd, 2017.

4. Harford, T. “The Economics of Trust.” *Forbes*. November 3, 2006. https://www.forbes.com/2006/09/22/trust-economy-markets-tech_cx_th_06trust_0925harford.html#5582cf62e138.

5. Botsman, R. “We've stopped trusting institutions and started trusting strangers.”. *TED*. YouTube video. November 7, 2016. https://www.youtube.com/watch?v=GqGksNRYu8s.

6. Cadwalladr, C., E. Graham-Harrison. “Revealed: 50 million Facebook profiles harvested for Cambridge Analytica in major data breach.” *The Guardian*. March 17, 2018. www.theguardian.com.

7. Brooks, P. A. “VW Notice of Violation, Clean Air Act.” *EPA*. September 18, 2015. https://www.epa.gov/sites/production/files/2015-10/documents/vw-nov-caa-09-18-15.pdf.

8. Rezendes, M. “Church allowed abuse by priest for years.” *The Boston Globe*. January 6, 2002. www.bostonglobe.com.

9. Edelman. “2018 Edelman Trust Barometer.” *Edelman*. 2018. https://www.edelman.com/trust-barometer.

10. Botsman, R. “We've stopped trusting institutions and started trusting strangers.”.

11. IDC. "New IDC Spending Guide Sees Worldwide Blockchain Spending Growing to 9.7 Billion in 2021." *IDC*. January 24, 2018. https://www.idc.com/getdoc.jsp?containerId=prUS43526618

12. Casey, M. "The Blockchain: Decentralized trust to unlock a decentralized future". *Oreilly*. September 8, 2016. https://www.oreilly.com/ideas/the-blockchain-decentralized-trust-to-unlock-a-decentralized-future

13. Elsden, C., A. Manohar, J. Briggs, M. Harding, C. Speed and J. Vines. "Making Sense of Blockchain Applications: A Typology for HCI." Paper presented at the *2018 CHI Conference on Human Factors in Computing Systems*, Montreal, Canada, April 21 – 26, 2018: 458

14. Diekhöner, P. K. *The Trust Economy*.

15. Elsden, C. et al. "Making Sense of Blockchain Applications".

that was established by other peers of the platform. This online reputation makes people feel accountable towards the other and subsequently gives people a feeling of trust. Many companies are using this system to establish interactions amongst strangers.
A more recent technology that supports these peer-to-peer interactions and tries to push away from trust in any institutions altogether is the blockchain technology.

Blockchain technology

In the year 2017 $945 million of venture funding was raised by blockchain companies with a forecasted total of $9.2 billion being spend on blockchain technology by the year 2021[11]. The valuation of the now more commonly known digital currency 'Bitcoin' reflects this interest (see figure 4).

Where the internet made it possible for people to share information freely amongst peers, blockchain technology allows people to exchange any valuable digital asset without having to rely on an intermediary. Currently institutions like banks are in place to make sure that when someone transfers money to someone else, that person a) actually has the money and b) did not already transfer it to someone else. Banks keep track of the current state of money ownership centrally (ledger). Blockchain decentralizes the ownership of this ledger as well as the validation process around transactions, making the execution of a transfer non-dependent on a central institute.

Blockchain can in this sense be seen as the enabler of distributed trust[12], but even doing so without any platform regulators nor peer-to-peer trust. Where online reputation systems are used to increase the perceived trustworthiness of other peers, blockchain technology assumes distrust between the peers and tries to enforce interactions by means of hard code, making it unnecessary to trust the peer one is interacting with. Elsden et al. state that people now have to trust in "… the enduring veracity of a technical process, rather than human trust in any individuals or institutions."[13].

Although promises are made on how blockchain technology can change the way trust is needed in our society, it seems that it has "a hard time convincing the world to trust its capability to create a well-functioning alternative currency system"[14]. There are also still many questions about how to "demonstrate and prove"[15] this new kind of trust. Eventhough potentially no more trust is needed in other peers, users still need to trust the underlying technology.

Figure 4: Graph of Bitcoin/USD exchange. Taken on May 18, 2018. Adapted from IEX.nl

ASSIGNMENT

The world is looking for other ways to trust in, and interact with, each other, and blockchain technology aims to solve this. This makes it an interesting topic to investigate. If it is not the other peer that we should trust, then we should somehow trust the technology.

Problem definition

Blockchain technology is created so peer-to-peer transactions of assets can take place without needing to trust one another. However, this doesn't necessarily mean that these entities will instantly trust the technology or system which the solution offers. As people move to not only exchanging information but also value through digital systems, free from any trusted middle man, it is increasingly important that users actually perceive these technology platforms and services as trustworthy. This is especially true for organizations in competing environments, such as the retail industry, where shared information and assets can be sensitive to the owners.

Different streams of literature have already explored trust in human computer interactions (HCI) and proposed relevant (design) frameworks[16,17]. Yet limited research has been done into this topic related to blockchain solutions[18]. Characteristics such as 'decentralized consensus and storage', 'autonomous execution', 'transparency' and 'cryptocurrencies' set the technology apart from existing technologies which most likely influence the extend to which a user perceives the system as trustworthy.

Many applications for blockchain technology have been explored from a technological and business point of view, but designing for the experience around it has only started to receive attention more recently[19]. Trust in a technology is an important indicator in determining whether people will continue to use a technology or not[20]. Cognizant often deals with these new technologies and is seeking for ways to make clients adopt these. It is therefore relevant to understand how trust in this specific technology can be designed for to increase the potential adoption of new service propositions.

Assignment

Design a service or experience that allows people to build (initial) trust in blockchain technology.

16. Pavlidis, M. "Designing for Trust" *CAiSE* (Doctoral Consortium) (2011): 3-14.

17. Riegelsberger, J., M.A. Sasse and J.D. McCarthy. "The mechanics of trust: A framework for research and design." *International Journal of Human-Computer Studies* 62, no. 3 (2005): 381-422.

18. Sas, C. and I.E. Khairuddin. "Design for Trust: An exploration of the challenges and opportunities of bitcoin users." Paper presented at the 2017 CHI Conference on Human Factors in Computing Systems, May, 2017: 6499-6510

19. Elsden, C. et al. "Making Sense of Blockchain Applications".

20. Pavlou, P.A. "Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model." *International journal of electronic commerce* 7, no. 3 (2003): 101-134.

APPROACH

In the broadest sense, this project follows a typical 'double-diamond' process, with a heavy focus on the 'discover' and 'define' phase due to the exploratory nature (see visual on below). For each of the four phases, different research and design activities were chosen and executed based on the identified gaps or necessary valiadation. Key activities will be shortly addressed below.

Discover

The main focus of this phase was on getting a thorough understanding of the concept of trust and its' relation to blockchain technology. This was achieved through a combination of a literature study on 'trust in technology' and a technology analysis. Finally a case study was performed to simultaneously observe these topics in practice. Results from these explorations led to an initial design direction.

Define

For the second phase the goal was to sharpen the direction into a clear design opportunity. Case studies helped to get an idea of existing solutions. Two expert interviews helped to find a right approach for the design direction. Creative sessions were organized to move from the abstract literature/research space towards concrete solutions. This phase ended with a sharpened design opportunity.

Develop

During this phase the design opportunity was explored to get to a final design solution. Iterating the solution through multiple experiments helped in achieving this. The first experiments used simple paper prototypes to validate the concept's functioning and impact. A final, refined, experiment was executed to collect feedback for future recommendations.

Deliver

In this phase a final design for the concept was proposed based on the findings of the experiments. Next to this an implementation plan and corresponding recommendations were given.

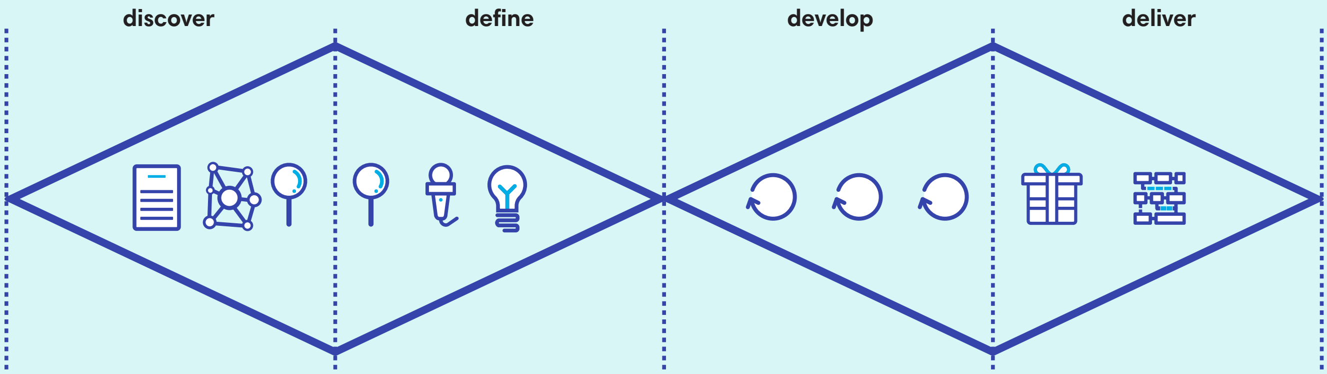


Figure x.x.: Approach taken for this project

chapter 2

Trust in technology

This chapter describes the mechanics of trust and the elements that influence how people build trust in new technology. The first part is about understanding how trust works where the second part looks at how trust can be designed for.

TECHNOLOGY ADOPTION TRUST

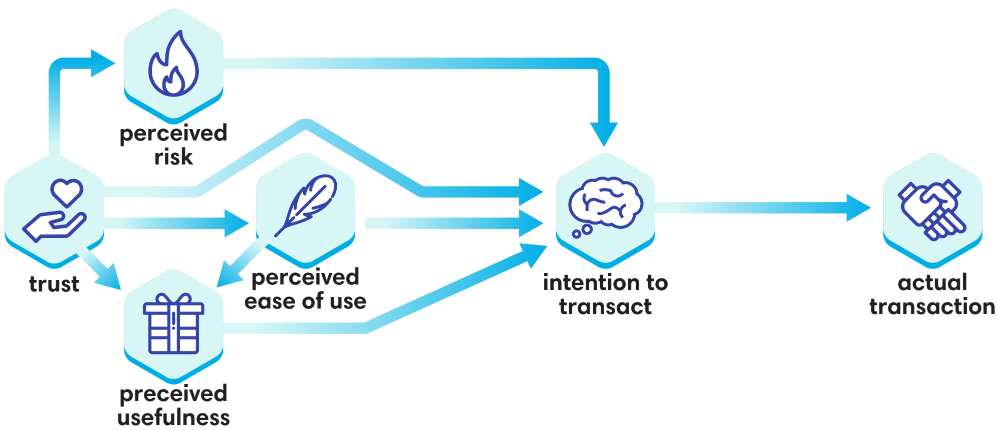


Figure 5: Technology adoption model

Before diving into the topic of trust in technology, it is important to understand why this trust is relevant. In the end the goal is for users or clients to adopt or use the blockchain technology. For investigating this technology adoption and the intention of someone to use a new technology, the Technology Adoption Model (TAM) is often used (see figure 5.). Multiple studies have confirmed that besides 'perceived usefulness' and 'perceived ease of use', 'trust' and 'perceived risk' influence the intention of someone to adopt a new technology.[21,22,23] This implicates that trust in a technology is important for a user to adopt a technology and is a relevant topic for this research project.

Innovation perceived attirbutes

The five perceived attributes of innovation by Rogers [24] (see figure 6) are often used to predict the rate of adoption of an innovation. These components provide a first indication of what elements are important to highlight when users

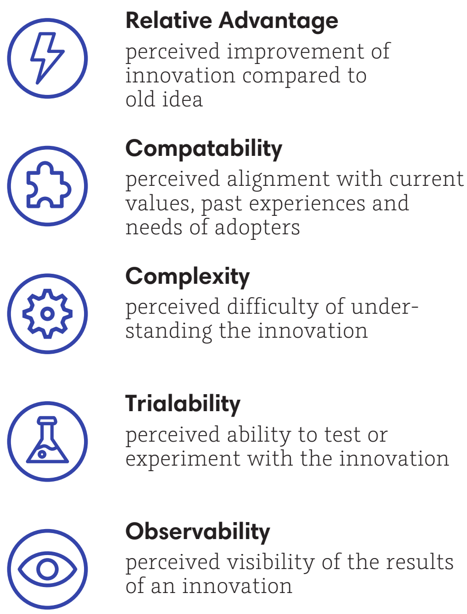


Figure 6: Rogers perceived attributes of innovation

21. Pavlou, P.A. "Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model." 101-134;

22. McKnight, D.H., M. Carter, J.B. Thatcher and P.F. Clay. "Trust in a specific technology: An investigation of its components and measures. *ACM Transactions on Management Information Systems (TMIS)* 2, no. 2 (2011): 12.

23. Miltgen, C.L., A. Popovic and T. Oliveira. "Determinants of end-user acceptance of biometrics: Integrating the 'Big 3' of technology acceptance with privacy context." *Decision Support Systems* 56 (2013): 103-114.

24. Rogers, E.M. and F.F. Schoemaker. *Communication of Innovations; A Cross-Cultural Approach.* New York, USA: Free Press, 1971.

are confronted with a new technology. They do however not necessarily affect trust directly.
An extensive amount of research has been done into technology adoption in organizations and among individuals, but this thesis will maintain its' focus specifically on 'trust in technology' and how this trust can be fostered.

DEFINING TRUST

Before being able to design for trust in technology, it is important to get a basic understanding of the mechanics behind trust. The concept of 'trust' has been researched extensively across different literature streams including philosophy, neurology, sociology, psychology, management, marketing and economics. However, there is no "universally accepted operationalization"[25] of trust and Bigley and Pearce[26] argue that trust should be approached in a problem-centric way where trust components are determined based on the context. Still, an often referred to, and agreed upon basic definition of trust, is the one proposed by Mayer et al.[27]. Trust is:

...the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor.

Mechanics of trust

A situation where trust is present always entails three components: 1) a trustor, 2) a trustee and 3) a desired performance[28]. The trustor is the trusting actor whilst the trustee is the actor who is being trusted to fulfill a certain exchange[29]. Both roles can be taken on by a person, company or product/technology. Next to this, trust becomes relevant when a trustor's trusting action involves uncertainty about the outcome and risk of winning or losing something[30, 31]. In a way, the trustor has to be dependent on the trustee for the success of the exchange and believes in something "despite its' uncertainty"[32].

Bridging uncertainty

As mentioned before, trust is needed only when one deals with uncertainty (see chapter 1). The bridge model (see figure 7)[33] portrays this as an uncertainty distance that needs to be crossed to go from 'wanting to transact' to 'actually transacting'. This uncertainty distance can increase by separation in time and space between the trustor and trustee[34]. The distance can be overcome through a combination of trust and (knowledge about) enforcements (e.g. litigation to force payment of damages made by the counterparty) which are in place. For individuals with a high risk-tolerance, the uncertainty distance might be smaller.

Trust stack

According to Botsman[35], when individuals encounter a new service or concept, the focus of trust moves along a so called 'trust stack' (see figure 8). First it's about whether people trust the

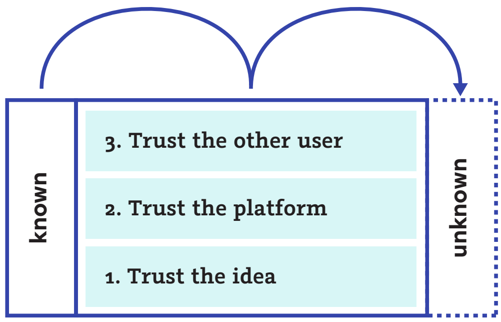


Figure 8: Trust stack (Adapted from Rachel Botsman)

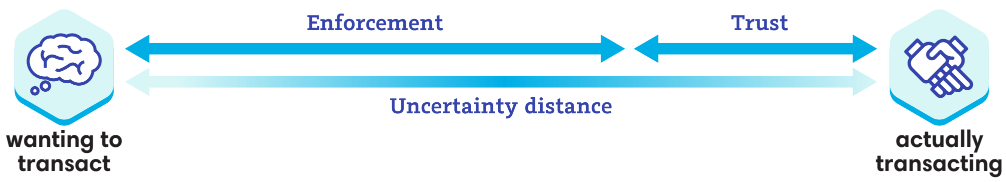


Figure 7: Uncertainty bridging model (Adapted from Riegelsberger)

25. Clegg, C., K. Unsworth, O. Epitropaki and G. Parker. "Implicating trust in the innovation process." *Journal of Occupational and Organizational Psychology* 75, no. 4 (2002): 409-422. P.1

26. Bigley, G. A., J. L. Pearce. "Straining for shared meaning in organization science: Problems of trust and distrust. *Academy of management review* 23, no. 3 (1998): 405-421.

27. Mayer, R.C., J.H. Davis and F.D. Schoorman. "An integrative model of organizational trust." Academy of management review 20, no. 3 (1995): 709-734. P.712

28. Baier, A. "Trust and antitrust." *Ethics* 96, no. 2 (1986): 231-260.

29. Riegelsberger, J., M.A. Sasse and J.D. McCarthy. "The mechanics of trust: A framework for research and design." 381-422.

30. Solhaug, B. and K. Stølen. "Uncertainty, subjectivity, trust and risk: How it all fits together." *International Workshop on Security and Trust Management*, Berlin, Heidelberg, June 2011: 1-5.

31. Bracamonte, V., H. Okada. "The issue of user trust in decentralized applications running on blockchain platforms." Paper presented at the *IEEE International Symposium on Technology and Society*, Sydney, Australia, August, 2017: 1-4.

32. Christopher, C. M. "The Bridging Model: Exploring the Roles of Trust and Enforcement in Banking, Bitcoin, and the Blockchain." *Nev. LJ* 17: 139.

33. Ibid.

34. Riegelsberger, J., M.A. Sasse and J.D. McCarthy. "The mechanics of trust: A framework for research and design." 381-422.

35. Botsman, R. "The three steps of building trust in new ideas and businesses." TED. December 8, 2017. https://ideas.ted.com/the-three-steps-of-building-trust-in-new-ideas-and-businesses/

36. Tan, Y and W. Thoen. "Toward a generic model of trust for electronic commerce." *International journal of electronic commerce* 5, no. 2 (2000): 61-74.

37. Riegelsberger, J., M.A. Sasse and J.D. McCarthy. "The mechanics of trust: A framework for research and design." 381-422.

38. Werbach, K. "Trustless trust." Paper presented at the *44th Research Conference on Communication, Information and Internet Policy*, Arlington, VA, September 30 – October 1, 2016.

39. Mayer, R.C., J.H. Davis and F.D. Schoorman. "An integrative model of organizational trust." *Academy of management review* 20, no. 3 (1995): 709-734.

idea, believes about whether the concept is oke and worth trying. Then the platform, will the providing party or system help when things go wrong (e.g. AirBnB). Finally its' about trusting the user with whom one is exchanging, how likely is it that he/she will fulfill the exchange. Blockchain technology promotes that this trust in the other user is no longer necessary. the uncertainty distance might be smaller.

Trust interaction

Blockchain technology is often applied to exchanges of valuable assets between multiple entities. It is therefore interesting to see how trust in an exchange functions.
Individuals will continue a transaction if their own level of trust is higher than their personal threshold. Transaction trust is built through external factors as well as internal factors (see figure 9, left). External factors include both trust in the other party as well as trust in the control mechanism which mediates the exchange.[36]

Looking at a trust interaction more closely (see figure 9, right)[37], a trustor generally receives signals about the trustee which shape the perceived trustworthiness of the trustee and subsequently help to formulate trust beliefs. After this the trustor can either withdraw from the exchange or perform a trusting action. This is where the risk is involved, because after a trustor decides to continue, the trustee can still decide whether he/she/it wants to defect or fulfill the exchange.

Werbach[38] describes two ways of establishing trust interaction ('architectures'): central authority and peer-to-peer. A middle man can essentially take on the role of creating trust amongst peers who don't necessarily trust each other. This way trust can be spread easier. In peer-to-peer trust people place trust directly into their transaction partner. This type of trust is often based on defined social norms and available reputation information.

TECHNOLOGY AND HUMAN TRUST

Much of the current understanding of the concept of trust has been obtained through studies into the development of trust between people. However, more and more research is studying the way in which humans place trust a specific technology. Both types of trust will now be defined.

Measuring trust in people

The measurement of a person's trust in another human being is mostly done by looking at three trusting beliefs: ability, benevolence and integrity[39] (see figure 11). **Ability**, also referred to as competence, is about the skills, competencies and characteristics that enable an entity to perform a desired action. These abilities are often perceived domain specific; an entity might

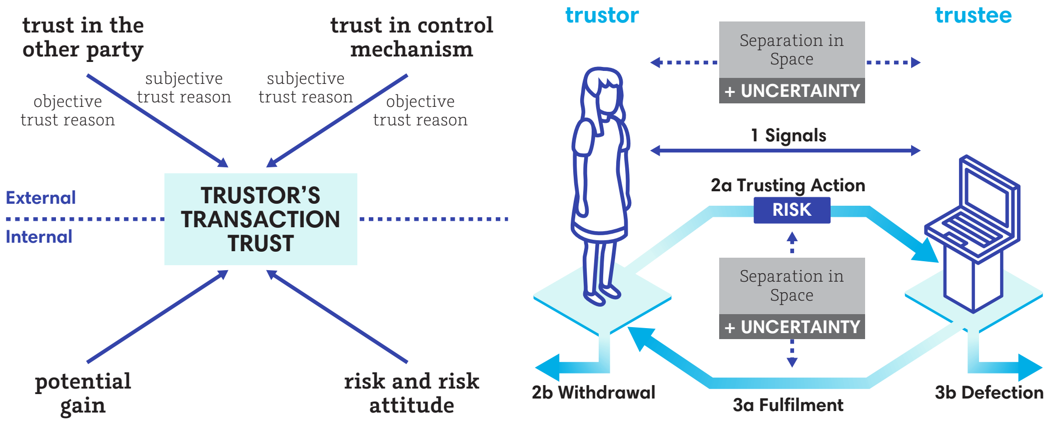


Figure 9: Left the generic model of trust by Tan and Thoen, Right the trust interaction model by Riegelsberger, Sasse and McCarthy.

be 'good' at something within a certain domain but not in another[39]. **Benevolence** is the belief that the trustee will want to do good to the trustor, even though "egocentric profit motives" may be present[39]. This often relates to personal orientation and how relevant the trustee is to the trustor's needs and desires. **Integrity** is about the adherence of the trustee to a set of principles or values deemed acceptable by the trustor[39].

Trust in technology

Human-like trust believes assume that the trustee has volition (free will) and can make its' own ethical decisions. Although discussions surrounding the developments in AI suggest that technology could one day obtain volition[40], many technologies act in a pre-programmed manner.

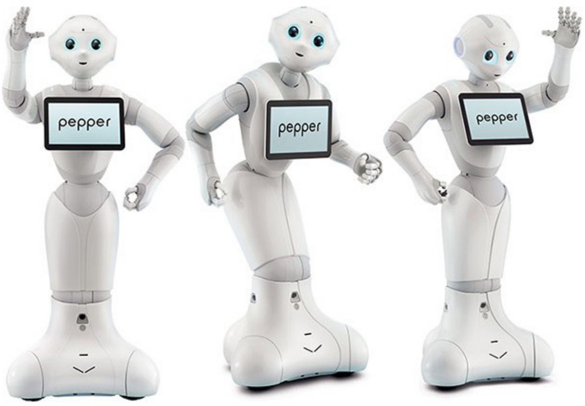


Figure 10: Image 'Pepper' the robot

For this reason 'system-like' trusting beliefs have been introduced to study trust in technology. McKnight et al.[41] proposed 'reliability', 'functionality' and 'helpfulness' as the technological counterparts to the human-like believes (see figure 11). **Reliability** is about whether someone expects technology to act consistently and predictably. **Functionality** concerns the believes one has of the capacity or capability to complete a necessary action. Finally, **helpfulness** is about the belief that a technology provides "adequate and responsive help"[42].

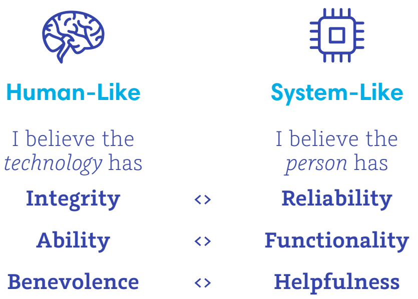


Figure 11: Human-like and system-like trust believes

Technology humanness

Even though these system-like believes have been setup, research has shown that people tend to anthropomorphize technologies[43] and "ascribe to them human motivation or human attributes"[44]. For example, people tend to think of robots as human (see figure 10) which could raise expectations of moral care, consideration and responsibility for its' own action[45]. This would mean that human-like trusting believes are suitable for designing for trust in some technologies.

Lankton et al.[46] shed a light on this topic and propose that people will form specific trust believes (human-like or system-like) based on the humanness of a technology. This can be determined by its' social presence, social affordances and affordances for sociality. Social presences concerns the extent to which a technology "allows a user to experience other individuals as being psychologically present"[47] either the technology itself (e.g. a robot with natural body language) or the perceived effect of the technology (e.g. Facebook's status updates). Social affordances is about whether the technology provides dynamic opportunities for action (e.g. chatbot which interprets and responds to human voices). Affordances for sociality are action potentials which a technology provides for users to enable interaction with other people.

It is therefore interesting to determine the humanness of blockchain technology (see chapter 3) to determine the believes that should be formed in individuals.

40. Ford, P. "Our Fear of Artificial Intelligence." MIT Technology Review. February 11, 2015. https://www.technologyreview.com/s/534871/our-fear-of-artificial-intelligence/

41. McKnight, D.H., M. Carter, J.B. Thatcher and P.F. Clay. "Trust in a specific technology: An investigation of its components and measures. *ACM Transactions on Management Information Systems (TMIS)* 2, no. 2 (2011): 12.

42. Ibid., 6.

43. Nowak, K. L. and C. Rauh. "The influence of the avatar on online perceptions of anthropomorphism, androgyny, credibility, homophily, and attraction." *Journal of Computer-Mediated Communication* 11, no. 1 (2005): 153-178

44. Lankton, N.K., D.H. McKnight and J. Tripp. "Technology, humanness, and trust: Rethinking trust in technology." *Journal of the Association for Information Systems* 16, no. 10 (2015): 883.

45. Nauert PhD, R. "Why Do We Anthropomorphize?" *Psych Central*. 2015. Accessed May 30, 2018. https://psychcentral.com/news/2010/03/01/why-do-we-anthropomorphize/11766.html

46. Lankton, N.K., D.H. McKnight and J. Tripp. "Technology, humanness, and trust: Rethinking trust in technology."

47. Ibid., 884.

Figure 12.: Three stages of trust development

TRUST DEVELOPMENT BASES

The development of trust occurs in stages. Trust in a person or technology is not static. But rather than evolving linearly, it develops in phases. Each phase has its' own characteristics and bases which individuals use to build trust.

In the evolvement of trust relationships between a trustor and trustee different types of trust developments can be identified[48]: calculus-based trust, knowledge-based trust and identification-based trust (see figure 12). The first phase is also often referred to as 'initial trust' where calculus-based trust can be seen as a form of initial trust[33]. Trust always involves a combination of cognitive as well as affective trust[49]. Cognitive is about rational calculations and affective about expectations of goodwill[50]. Trust is build on different trusting bases (see figure 13).

INITIAL TRUST

Initial trust is about the judgements a trustor forms before experiencing or gaining first-hand knowledge about the trustee[51]. These judgements are based on other sources such as second-hand knowledge (e.g. opinions about the technology) or experiences with other systems. Initial trust is fragile, and when broken, can set a user back more than the original trust starting point[52]. To form the necessary believes for trust, people will gather and use information regarding certain 'trusting bases'. There are five key trusting bases that relate to initial trust in technology[53].

Personality base

This deals with someone's own propensity to trust[54] which is a general willingness to trust others. This can be different for each individual due to personality type, developmental experiences or cultural background and are therefore harder to influence. There are three subcomponents:

Faith in humanity or general technology[55] is about people's general trust in and preconceptions about (non)human objects. Individuals with a strong faith in humanity might assume the good nature of a new technology that was developed by people more easily[56].

Trusting stance is about someone's belief that dealing with a trustee (person or technology) as if it were reliable, despite its real attributes, will give positive outcomes[57].

Cognitive base

In this case cognitive-based trust can be seen as knowledge-based trust before any interaction has taken place. It can be based on second-hand knowledge or cognitive cues as long as these provide evidence for the trustworthiness of the trustee. An important subcomponent of cognitive base is 'reputation'. As seen with platforms like AirBnB, individuals can deem an unfamiliar entity as trustworthy or untrustworthy based purely on its' reputation. This perceived reputation may be build based on the expressed opinions of others who have interacted with a similar kind of technology. Other examples can be labels or marks of quality.

Calculative base

This trusting base arises from the fact that trustors will mostly consider a trustee to act in its own interest in a calculative and rational manner but will avoid opportunistic behaviour when the costs of acting untrustworthy are greater than the benefits[58]. For trust in technology cases trustors often refer to the operator of the technology, rather than the technology itself, as the entity that can choose how to perform (e.g. misuse/abuse personal information from the system)

Institutional base

Institutional-based trust relates to the (social) context in which a technology interaction takes place. Trust is more easily granted when the right institutional structures are available and the environment seems "in proper order"[59]. This

48. Lewicki, R.J., B.B. Bunker. "Developing and maintaining trust in work relationships." *Trust in organizations: Frontiers of theory and research* 114 (1996): 139.

49. Cross, F. B. "Law and trust." *Geo LJ* 93 (2004): 1457

50. Werbach, K. "Trustless trust."

51. Li, X., T.J. Hess and J.S. Valacich. "Why do we trust new technology? A study of initial trust formation with organizational information systems." *The Journal of Strategic Information Systems* 17, no. 1 (2008): 39-71.

52. Lewicki, R.J., B.B. Bunker. "Developing and maintaining trust in work relationships."

53. Li, X., T.J. Hess and J.S. Valacich. "Why do we trust new technology? A study of initial trust formation with organizational information systems."

54. Mayer, R.C., J.H. Davis and F.D. Schoorman. "An integrative model of organizational trust."

55. McKnight, D.H., M. Carter, J.B. Thatcher and P.F. Clay. "Trust in a specific technology: An investigation of its components and measures."

56. Li, X., T.J. Hess and J.S. Valacich. "Why do we trust new technology? A study of initial trust formation with organizational information systems."

57. Riker, W.H. "The nature of trust" *Social Power and Political Influence* (2017): 63-81.

58. Li, X., T.J. Hess and J.S. Valacich. "Why do we trust new technology? A study of initial trust formation with organizational information systems."

59. Ibid., 46.

trusting base applies both to organizations as well as technology and has two subcomponents. In this case organizations refer to the party who might own, introduce or support the technology. Two subcomponents exist:

Structural assurance refers to the factors in the environment that make the trustor feel safe and secure[60] and believe that the trustee will do its best to fulfill the interaction[61]. For the organizational base this can be contracts, laws or guarantees[62]. An example is a bank clerk who will follow the rules of the company as to not lose his or her job and will thus receive more trust by the trustor[63]. From a technology perspective this is about attributes of the platform and infrastructure which host the technology. This might be encryption, third-party certificates[64] or sufficient support in case of faulty equipment.[65]

Situational normality is about the extent to which a situation is normal and 'well-ordered' to allow for trust in something new[66]. Scenarios which are more acceptable and anticipated will foster more trust than ones that is abnormal and uncomfortable.[67] This also relates to previous direct experiences which someone might have had with similar technologies or organizations. For technology it refers to the believe that the usage of a certain type of technology in a new way can be normal for certain settings[68].
These trusting bases do not apply to all scenario's.[69] It depends on the technology that needs to be trusted

KNOWLEDGE BASED TRUST

Knowledge-based trust starts to develop when previous interactions allow the trustor to know the trustee in such a way that predictions can be made about its' behavior in a certain situation[70]. During this phase trust is formed by three components: collecting as much first-hand information about the trustee as possible, defining its predictability and developing an understanding of the trustee through multiple interaction.[71] Engaging in trust-related behaviours gives individuals the chance to assess the trustworthiness of the trustee by "observing the consequences of those behaviors".[72] McKnight et al. reason that this might be the way to acquire credible and meaningful information and go from being unfamiliar to familiar actors. This phase is about exploring the trustee under different circumstances and trust will not be broken immediately when inconsistent behavior occurs. Additionally, during the knowledge-based trust phase, it may be that individuals focus less on institutional trust and more on attributes of the technology (functionality, reliability and helpfulness).

IDENTIFICATION BASED TRUST

This type of trust is established when parties can identify with the desires and intentions of one another. Eventually, a deep understanding and sharing of the each others needs, choices and preferences should make it possible for one party to "act for the other"[73]. Only a few personal trust relationships reach this level. As most technologies don't have their own beliefs or ethics, this relationship type does not apply to technologies.

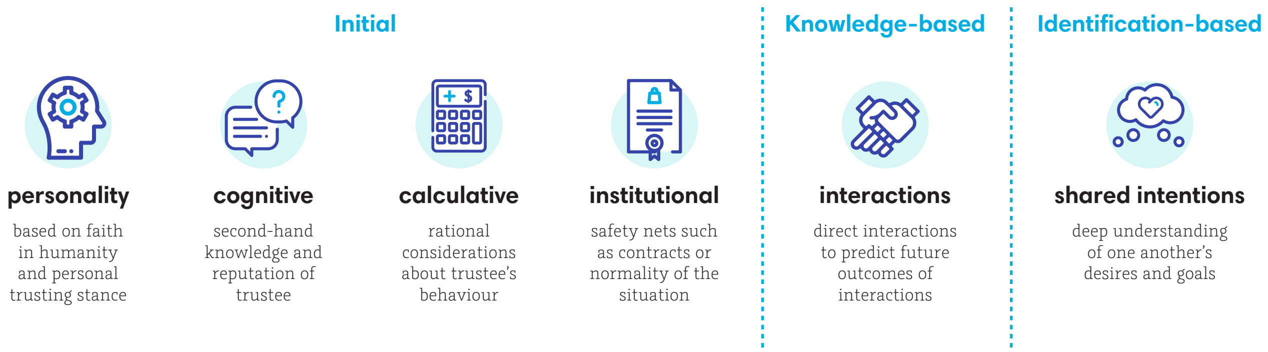


Figure 13: Overview of trusting bases

60. McKnight, D.H., V. Choudhury and C. Kacmar. "The impact of initial consumer trust on intentions to transact with a web site: a trust building model. *The journal of strategic information systems* 11 no. 3-4 (2002): 297-323.

61. Sitkin, S.B. and L.R. Weingart. "Determinants of risky decision-making behavior: A test of the mediating role of risk perceptions and propensity." *Academy of management Journal* 38, no. 6 (1995): 1573-1592.

62. Li, X., T.J. Hess and J.S. Valacich. "Why do we trust new technology? A study of initial trust formation with organizational information systems."

63. Riegelsberger, J., M.A. Sasse and J.D. McCarthy. "The mechanics of trust: A framework for research and design." 381-422.

64. Luo, X. "Trust production and privacy concerns on the Internet: A framework based on relationship marketing and social exchange theory." *Industrial Marketing Management* 31, no. 2 (2002): 111-118

65. McKnight, D.H., M. Carter, J.B. Thatcher and P.F. Clay. "Trust in a specific technology: An investigation of its components and measures."

66. Ibid.

67. Li, X., T.J. Hess and J.S. Valacich. "Why do we trust new technology? A study of initial trust formation with organizational information systems."

68. McKnight, D.H. and N.L. Chervany. "What trust means in e-commerce customer relationships: An interdisciplinary conceptual typology." *International journal of electronic commerce* 6, no. 2 (2001): 35-59.

69. Li, X., T.J. Hess and J.S. Valacich. "Why do we trust new technology? A study of initial trust formation with organizational information systems."

70. Lewicki, R.J., B.B. Bunker. "Developing and maintaining trust in work relationships."
71. Ibid.
72. McKnight, D.H., V. Choudhury and C. Kacmar. "The impact of initial consumer trust on intentions to transact with a web site: a trust building model. *The journal of strategic information systems*, 11 no. 3-4 (2002): 297-323.
73. Ibid.
74. Lewicki, R.J., B.B. Bunker. "Developing and maintaining trust in work relationships."

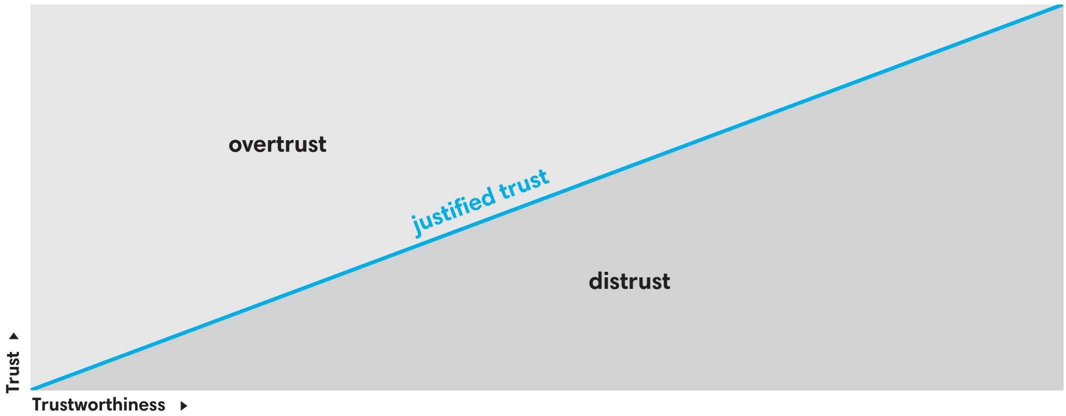


Figure 14 Graphical representation of trust and trustworthiness

DESIGNING FOR TRUST

Justified trust

In the design for trust the goal is to match the level of perceived trust to the objective level of trustworthiness whilst making the most benefit happen, also referred to as 'justified trust'[75] (see figure 14). Trusting more than the actual trustworthiness of a trustee would make the trustor 'vulnerable'[76] and place the trustor in a position of 'overtrust'. A good example of this is Facebook (see figure 15) where users seem to share too much on the platform whilst deeming the company more trustworthy than it actually is. If users 'overtrust' a technology there is a higher chance for potential breach of trust when the system does not perform as expected which can "highly influence user perception of that technology"[77]. Trusting less than the actual trustworthiness of a trustee would mean a "loss of opportunities"[78] and places the trustor in a position of 'distrust'. One of the reasons why the Google glass, launched in 2013, was not adopted is because people did not trust the glasses to stop filming when near strangers[79]. Even though the technology did indeed not film at such moments and thus could objectively speaking be seen as trustworthy. Establishing this balance can be achieved by either altering the objective trustworthiness of the trustee or the trust by the trustor[80].

Based on this it might be interesting to not only look at increasing the perceived trust of blockchain technology but also the objective trustworthiness of the technology (see chapter 3).

75. Cofta, P. "Trust, complexity and control: confidence in a convergent world." *John Wiley & Sons.* 2007.

76. Pavlidis, M. "Designing for Trust", 3-14.

77. O'Kane, A.A., C. Detweiler and A. Pommeranz. "Designing and evaluating for trust: a perspective from the new practitioners." *1st International Workshop on Values in Design-Building Bridges between RE, HCI and Ethics.* September, 2011: 54.

78. Pavlidis, M. "Designing for Trust", 4.

79. Hurst, M. "The Google Glass feature no one is talking about." *Creative Good.* February 28, 2013. http://creativegood.com/blog/the-google-glass-feature-no-one-is-talking-about/

80. Nickel, P.J. "Design for the Value of Trust." *Handbook of Ethics, Values and Technological Design: Sources, Theory, Values and Application Domains* (2015): 551-567.

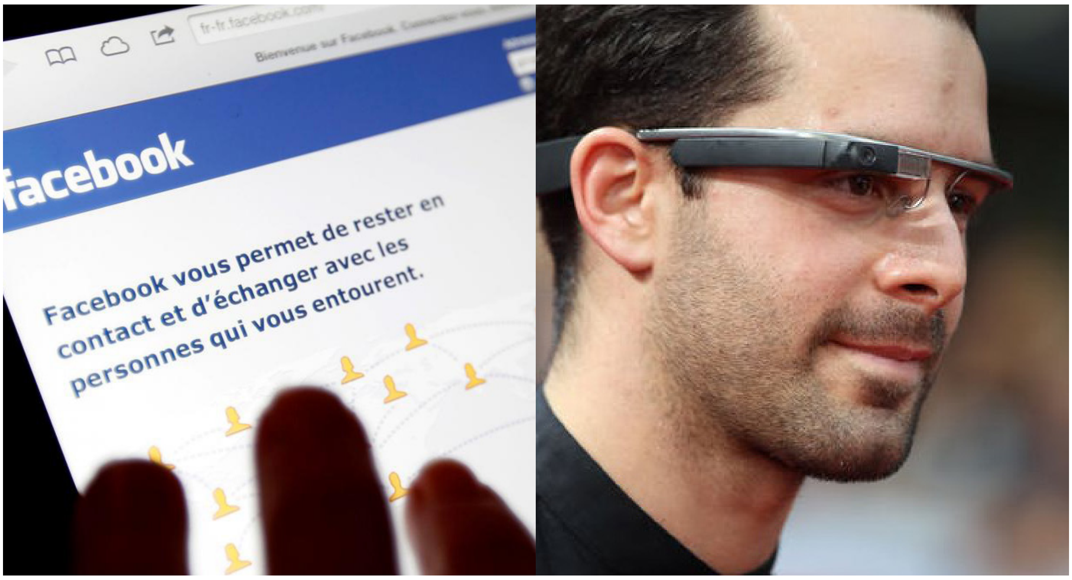


Figure 15: Image of Facebook website and person wearing Google glass.

CONCLUSION

This chapter is rounded off by discussing the most relevant findings from the literature review and providing the first design guidelines for the design challenge.

People build trust in technology to do something
Trust cannot be formulated towards a technology in general, it should always be paired with a desired action which involves uncertainty and risk (e.g. one cannot formulate general trust in the internet in its entirety but can formulate trust in internet banking for transferring money to someone else). It is still interesting to see where uncertainties might lie when interacting with a blockchain technology but designing for trust should take place in the context of an activity.

It depends on the technology and scenario which trusting bases people rely on
Initial trust believes seem to be shaped on the basis of multiple information and personality sources. Some of these can be influenced directly. For example, create an environment/activity which people can relate to or perceive as 'normal' (situational normality) or provide information with regards to the technological safety nets available (structural assurance). Others are hard to adjust such as someone's general faith in humanity because this is based on cultural backgrounds. As shown in the literature, it depends on the technology and scenario which of these trusting bases individuals will fall back on.

It is therefore interesting to see specifically for blockchain technology if and if so, what trusting bases will most likely play a key role in building initial trust.

After building initial trust it is trust interactions which build the strongest trust
Gaining actual first-hand experience and completing trust interactions with a technology will give people the ability to predict a technology's behaviour and so increase the level of trust. This trust is also stronger than only formulating initial trust through secondary knowledge. It is important to remember however, that trust is domain specific. Someone might trust blockchain technology to fulfill one activity, but this trust cannot always be carried over to a completely different activity.

Main impact on design challenge

The main takeaway from this chapter is the fact that trust interactions build trust. So the design should not only focus on providing information but also a real trust interaction. Next to this the perceived trustworthiness should be matched with the actual trustworthiness of the system in order for people to not be dissapointed when things do go wrong. As technologies become more and more omplex, it's almost an ethical thing to design for justified trust.

For the next chapter about blockchain technology it is interesting to determine where uncertainty/ risks might occur, the humanness of the technology and the actual trustworthiness.

TAKEAWAYS FOR COGNIZANT

Map desired actions and uncertainties/risks of target audience

Trust is an important factor for technoloy adoption as it helps to bridge perceived risks. For consulting this means that it is not only about talking about benefits or ease of use, but also targeting the aspects that clients or users might find risky or will be uncertain about later on. For service propositions, mapping actions that users need to take and the corresponding uncertainties/risks along a customer journey can be a way of identifying gaps where trust is needed. Subsequently thinking about how to provide users with signals about the trustworthiness of the trustee (technology/system/person) that relate to that specific action can speed up adoption of the new service.

Provide experiences, not only knowledge

It is often tempting and easy to use a slidedeck to explain how a certain technology can support a client. In light of trust--building it would be even better to have clients experience it themselves. Interactions like the AI-powered recognition screen in the entrance hall are great. However, adding an element of uncertainty/risk to the interaction would require the client to actually trust the technology and subsequently build stronger trust in the technology's capabilities. It would be amazing to offer 'Mini technology experiences' for different kind of functions of the technology.

chapter 3

Decomposing blockchain technology

This chapter will focus on the key workings of blockchain technology, its core value proposition and its components. A good understanding of the technology will help in determining what it is that 'people' actually need to trust when confronted with blockchain technology. Next to this the elements that build up the trustworthiness of a blockchain.

After receiving a lot of media attention, often being hailed as 'the most disruptive tech in decades'[81] and how it could 'change the world'[82], companies are now trying to figure out what the real use cases are for blockchain technology. Gartner's Hype Cycle[83] (see figure 16) indicates that the technology has progressed past its' 'Peak of Inflated Expectations' and will slowly drift towards the 'Trough of Disillusionment' where companies start to lose some interest as they realize that it might not deliver on all that was promised. Gartner predicts mainstream adoption of the technology to take place in 5-10 years. To understand how trust relates to blockchain it is important to understand the components it is made up of, the way in which it is presented to clients and the factors that influence the narrative surrounding it.

WHAT IT IS

Blockchain is an infrastructural technology that

81. Mearian, L. "What is Blockchain? The most disruptive tech in decades." *Computerworld*. January 18, 2018. https://www.computerworld.com/article/3191077/security/what-is-blockchain-the-most-disruptive-tech-in-decades.html.

82. Marlin, D. "What Is Blockchain And How Will It Change The World?" *Forbes*. December 22, 2017. https://www.forbes.com/sites/danielmarlin/2017/12/22/what-is-blockchain-and-how-will-it-change-the-world/#30dae25b7560.

83. Panetta, K. "Top Trends in the Gartner Hype Cycle for Emerging Technologies." *Gartner*. August 15, 2017. https://www.gartner.com/smarterwithgartner/top-trends-in-the-gartner-hype-cycle-for-emerging-technologies-2017/

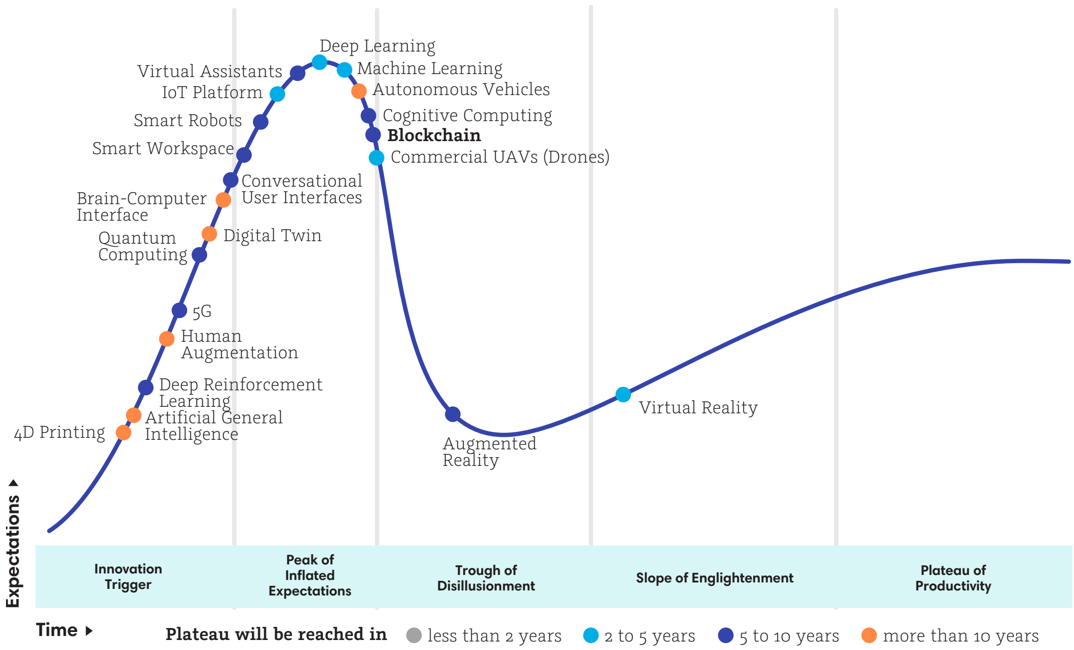


Figure 16 Gartner Hype Cycle for Emerging Technologies 2017. (Adapted from Gartner).

offers a way of exchanging digital assets (e.g. files, information) in a peer-to-peer manner whilst guaranteeing a "legitimacy of the transfer".[84] In essence it's a ledger of transactions which is distributed amongst a group of peers where each update is continuously checked for correctness by (all) members of the group. The technology has multiple technological levels and purpose

Technology	Description
distributed ledger	shared database between multiple entities whom all possess read and write permissions
immutable storage	changes to the ledger are stored in 'blocks' and sequenced in an immutable chain across al copies of the database
consensus algorithm	protocols for entities to verify proposed transactions and reach secure and shared consensus about the new database state

Figure 17: Blockchain's three technologies

categories[85] and consists of three different core technologies (see figure 17).[86]
Although it often uses the internet, it differs from the internet in the sense that it supports digital assets to be exchanged online whilst simultaneously assuring that the assets maintain their value. Currently, a PDF attachment to an e-mail can be freely copied and will thus lose its value due to abundant availability. For items such as digital art, home ownership statements and money this is unwanted. Until now these sort of items, which require a regulated scarcity, have been exchanged with the help of central third parties such as banks, notaries and governments. Currently these central entities keep track of transactions (who owns what) in a central ledger which only they control. Blockchains' newness comes from the fact that it supports these exchanges without the need for a third party

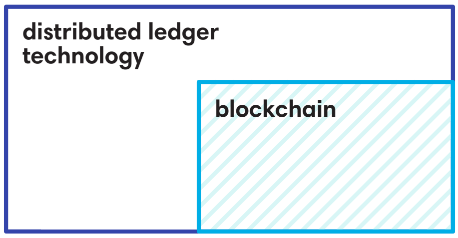


Figure 18: Blockchain is a subset of distributed ledger technology

and solves the so-called 'double spend problem' through the inherent cryptographic protocols[87] (see 2.2).
Although the word 'Blockchain' is commonly used to refer to this new technology, it officially falls under the umbrella of 'distributed ledger technology' (DLT) (see figure 18). A blockchain is one of the ways in which a 'distributed ledger' can be executed. Many different organizations and foundations such as IoTA, Lisk, Corda and Bitcoin are looking at ways to optimize these 'blockchain' protocols (see Application chapter)[88]. For the sake of clarity, this report will refer to 'blockchain' for all different types of distributed ledger varieties.

HOW IT WORKS

Different blockchains function in different ways but a basic explanation will be given. As mentioned before, the principle is that rather than having one central entity (e.g. a bank) maintaining a record of all ongoing transactions for all the involved peers, all peers each own a copy of the record. The main goal is to make sure that all peers in the ecosystem are 'looking' at the (same) truth at all times.

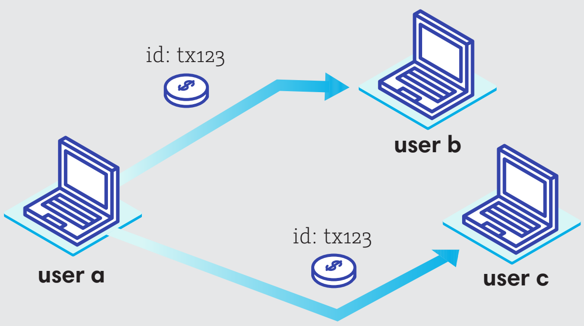
84. Andreessen, M. "Why Bitcoin Matters." *The New York Times*. 2014.

85. Swan, M. *Blockchain: Blueprint for a new economy*. O'Reilly Media, 2015.

86. Elsden, C., A. Manohar, J. Briggs, M. Harding, C. Speed and J. Vines. "Making Sense of Blockchain Applications: A Typology for HCI.".

87. Swan, M. *Blockchain: Blueprint for a new economy*.

88. Elsden, C., A. Manohar, J. Briggs, M. Harding, C. Speed and J. Vines. "Making Sense of Blockchain Applications: A Typology for HCI.".



FAQ DOUBLE SPEND PROBLEM

In general, assets maintain value when their scarcity is fixed. However, in the digital realm assets can be copied relatively easy. If someone would be able to transfer the same digital euro to two different people, that euro loses its value as the euro grows in availability. For this reason banks are in place to consolidate each transaction. Blockchain offers a way to achieve this consolidation as well, without an extra party.

Distributed database

The ledger record is structured as a chain of timestamped blocks which contain information about transactions that took place at those timestamped moments. Each block is linked to the previous block using a cryptographic hash (a reference code). Using this available information, new transactions can be validated by the network. An example with digital mone: if Susan wants to transfer 5 Bitcoins to Ralph, the network will check whether all previously completed transactions which relate to Susan, actually result in Susan owning 5 Bitcoins. If this is the case, the transaction to Ralph is validated for being correct. Besides checking whether Susan actually has the 5 Bitcoins to spend, the network still needs to prevent her from spending it on both Ralph and her other friend Michael at the same time (also referred to as the double spending, see FAQ above). This is important, because assets which are copied will lose their value. Checking for 'uniqueness' is done through a consensus algorithm.

Consensus algorithm

In order to reach an unbiased verification of new transactions, a decentralized consensus algorithm is needed. This should incentivize (some) members of the network, who are not involved in the new transaction, to check the uniqueness of a new transaction and propagate a correct answer to other peers. When other peers support the answer, the blockchain gets updated. Any block that has been accepted is immutable due to this shared consensus mechanicsm.[89]

A well-known algorithm is the 'proof-of-work' (see FAQ) as used in the Bitcoin blockchain but other consensus mechanisms such as proof-of-stake[90] have been introduced. In more private blockchains (e.g. Corda) where no digital currencies are in play to incentivize miners, notaries can be used. Uniqueness is provided by a separate notary node in the network[91] who is trusted by the other nodes to provide that service in a correct way. Many different ways of applying blockchain and consensus mechanisms are still being explored.

Blockchain classification

Similar to the start of the internet, many different types of 'blockchain' networks currently exist in parallel. In principal, any person with coding skills could set up a new network. These blockchains can have a different degree of decentralization, access control and consensus mechanisms which could affect the trustworthiness of the system. One key aspect is the 'governance', who is allowed to make changes to the underlying protocol. A high-level way to classify blockchains is in the terms 'persmissionless' and 'permissioned' (see figure 19)

Permissionless blockchain
- No specific owner
- Anyone can join and contribute
- No personal identification[92]
- Pseudonymous public address[93]
- Nodes have similar copy of ledger
- Anyone can verify transactions[94]

Permissioned blockchain
- Can be owned by one or more peers
- Participants are screened
- Identities are known[95]
- Varying read and write rights
- Consensus through simple protocol
- Greater speed of validation[96]
- Validation by trusted partner[97]

Figure 19: Permissioned versus permissionless blockchain

89. Deloitte. "Blockchain – Legal implications, questions, opportunities and risks." *Deloitte*. March, 2018. https://www2.deloitte.com/content/dam/Deloitte/be/Documents/legal/Blockchain%20Booklet%20March2018.pdf.

90. Kostarev, G. "Review of blockchain consensus mechanisms." *Medium*. July 31, 2017. https://blog.wavesplatform.com/review-of-blockchain-consensus-mechanisms-f575afae38f2.

91. Corda. "Notaries". *Corda*. https://docs.corda.net/key-concepts-notaries.html

92. Deloitte. "Blockchain – Legal implications, questions, opportunities and risks.".

93. Moy, J. "Forget Bitcoin, It's All About The Blockchain". *Forbes*. February 22, 2018. https://www.forbes.com/sites/jamiemoy/2018/02/22/forget-bitcoin-its-all-about-the-blockchain/2/#50a64e434719

94. Butterin, V. "On Public and Private Blockchains." *Ethereum.org*. August 7, 2015. https://blog.ethereum.org/2015/08/07/on-public-and-private-blockchains/

95. Deloitte. "Blockchain – Legal implications, questions, opportunities and risks.".

96. Butterin, V. "On Public and Private Blockchains."

97. Walport, M. "Distributed Ledger Technology: beyonc blockchain." *Government Office for Science*. 2016. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf

FAQ PROOF OF WORK

For new transactions, some nodes in the network ('miners') race to solve a complex mathematical puzzle. The answer is shared with the network for checking. When enough peers accept the solution, the block is added to the blockchain. Because these calculations differ in the time they take, no blocks will ever be approved simultaneously, solving the double spend problem. The fastest miner gets a reward in the form of cryptocurrency (e.g. 12.5 BTC) for investing electricity and computer power that was used during the calculations. This reward is released by the protocol and is provided in a finite supply. As these cryptocurrencies have real value, miners are incentivized to keep validating new transactions that come in and keep the system running and 'true' at all times.

WHY USE BLOCKCHAIN

Blockchain technology is indexed as the fifth computing paradigm with the potential for "reconfiguring all human activities as pervasively as did the Web"[98] (see figure 20). It seems that the core value proposition which it brings is the fact that individuals and organizations who want to exchange valuable assets amongst each other are not required to trust each other[99] but rather algorithms which are "open-source cryptographic protocols"[100]. It is also important to note that in contrast to proprietary technologies (e.g. VR, digital photography, patents) which can provide value when owned by a single company, blockchain is an infrastructural technology which offers the most value when shared with others (similar to railroads and the internet). Werbach defines two major scenarios where blockchain's value reaches its full potential: 1. dealing with untrustworthy actors and 2. a need for speed and efficiency (see 101).

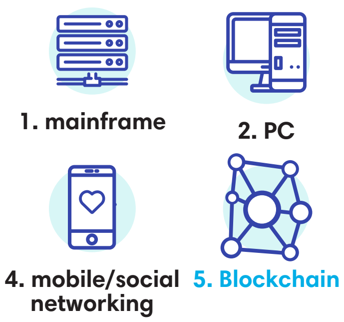


Figure 20: Computer paradigms

The **first** major impact is the ability to interact with peers one might not trust in the first place. This can be valuable for both the trustor and trustee. If a certain company feels it is acting trustworthy but isn't trusted by its users (distrust, see chapter 2) it could potentially make use of a blockchain to skip the direct trust relationship building and bridge it differently. Similarly, trustors who feel that certain companies or peers are not trustworthy, but would like to interact with those (e.g. corrupt government) could move their activities onto a blockchain.

The **second** major impact is the cost reduction for transactions by diminishing the so called 'trust tax'.[102] Although trust is an essential part for making value chains work (e.g. people buy products because they trust a brand), it imposes costs on all participants.[103] Figure 21 shows some examples of institutions that are currently valued and paid for bringing trust into our world. This cost is driven by three factors: a) middlemen also need to establish their own trust relationships to consolidate their books, b) the opportunity for a middleman to use its' power position to extract more value from a transaction (e.g. commission/ fee) and c) the serial process of reconciliation for each individual ledger.[104] Blockchain systems

Figure 21: Examples of middle men that are paid for providing trust

replace these trust building activities by code which makes the trust it brings 'scalable' and less costly. Next to this it allows for books to be update simultaneously for all peers in the network making it more efficient.

Individual's perspective

Although blockchain allows for a completely new range of applications (see 'Applications' on the next page) there seem to be three key activities which the technology brings to an individual[105]:

Asset tokenization

This means individuals can represent (physical) assets digitally as an unique item in a cost-effective

98. Swan, M. *Blockchain: Blueprint for a new economy*. vii

99. Ibid.

100. Werbach, K. "Trustless trust.", 21.

101. O'Connor, C. "What blockchain means for you, and the Internet of Things." *IBM*. February 10, 2017. https://www.ibm.com/blogs/internet-of-things/watson-iot-blockchain/; Ianisiti, M. and K.R. Lakhani. "The Truth About Blockchain." *HBR*. January, 2017. https://hbr.org/2017/01/the-truth-about-blockchain; Chintamaneni, P. and L. Varghese. "Blockchain: Instead of Why, Ask Why Not?" *Cognizant*. 2016. https://www.cognizant.com/whitepapers/Blockchain-Instead-of-Why-Ask-Why-Not-codex1973.pdf; Wüst, K. and A. Gervais. "Do you need a Blockchain?." *IACR Cryptology ePrint Archive* (2017): 375;

102. Blechschmidt, B., C. Stöcker. "How Blockchain Can Slash the Manufacturing "Trust Tax". Cognizant. 2016. https://www.cognizant.com/whitepapers/how-blockchain-can-slash-the-manufacturing-trust-tax-codex2279.pdf.

103. Ibid.

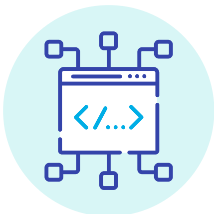
104. Werbach, K. "Trustless trust.".

105. Carmody, B. "Beyond Crypto-Mania: Understanding The True Value of Blockchain." INC. January 21, 2018. https://www.inc.com/bill-carmody/beyond-crypto-mania-understanding-true-value-of-blockchain.html.

way. By placing an asset on the blockchain it is acknowledged as being unique in the network which attributes it a value. As it is represented digitally, it can be 'split up' into any amount of parts and sold like shares to other users. This unlocks the ability to exploit items which might be lying idle, are normally hard or costly to transfer (e.g diamonds, personal harddisk space, a house) but which do have value.

Asset ownership

This refers to the power which the creator of the asset has in terms of when or with whom the asset should be shared. Unlike the internet where asset flow freely (e.g. personal data), blockchain makes it easier to stay in control of this data.



Asset programmability

This makes it possible to govern the exchange of assets through predefined rules. Using smart contracts one can influence the 'behavior' of an asset itself rather than having to fall back of judicial systems and paper contracts.

THE VALUE IT BRINGS

The previous paragraph described what new activities blockchain allows. However, this newness only translates to value when it is applied in the right way. Where Bitcoin ignited a lot of usecases within the banking industry, blockchain usecases can now be found across a range of industries in both B2C as well as B2B environments (e.g. insurance, logistics, audit, healthcare). In terms of applicability of the technology, it is often divided in three stages: 1.0 'currency'; 2.0 'smart contracts' and 3.0 'Applications' or 'Dapps'.[106]

1. The first stage fits with 'asset tokenization' (see before) in the sense that blockchain allows scarcity for digital assets and thus a limited amount of digital 'tokens' could create a currency. As the whole network is sure that these tokens have a certain value, they can be used to pay for other products (e.g. pay coffee with bitcoin).

2. The second stage, smart contracts, is more disruptive. Smart contracts are forms of code distributed on a blockchain that represent business logic (e.g. 'IF x THEN y' rules). They can be defined as "computer programs that secure, enforce, and execute settlement of recorded agreements between people and organizations.[107]". These contracts are triggered either by a transaction on the blockchain or an external data input and will subsequently execute another predefined transaction (e.g. IF plane is delayed THEN refund ticket money). Some key attributes are: autonomous, no human interaction is needed for its execution; deterministic, they always handle input data in the same way[108]; observable, anyone can check the code and see how certain inputs will be handled.[109] The key value is in reducing manual labour (e.g. signing of arrival of freight in docks) and costs of judicial arbitration as no party can wilfully underperform (break from their duties).

3. The third, Dapps, can be seen as a (mobile) application of which the backend is decentralized across a blockchain. Dapps (short for 'Decentralized applications') often contain a set of smart contracts, data inputs and a front-end UX to access the backend. Example might be an application that allows people to sell their data to others (e.g. location, e-mail, contacts).

Applications

Besides these different layers of applicability, Elsden et al.[110] created a typology of current applications by analyzing 100 blockchain applications (see figure 22). Interesting thing here is that many companies are also working on the underlying infrastructure, as a common operationalization has not yet been agreed upon (and might never be).

106. Unibright.IO. "Blockchain evolution: from 1.0 to 4.0." *Medium*. December 7, 2017. https://medium.com/@UnibrightIO/blockchain-evolution-from-1-0-to-4-0-3fbdbccfc666

107. Tapscott, D. and A. Tapscott. Bockchain revolution: how the technology behind bitcoin is changing money, business, and the world. Penguin, 2016.

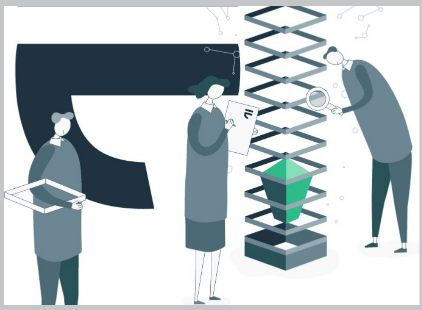
108. Christidis, K. and M. Devetsikiotis. "Blockchains and smart contracts for the internet of things." *IEEE Access*, 4 (2016): 2292-2303.

109. Ibid.

110. Elsden, C., A. Manohar, J. Briggs, M. Harding, C. Speed and J. Vines. "Making Sense of Blockchain Applications: A Typology for HCI.".

Application	Description
Underlying infrastructure	Underlying protocols, decentralized application ecosystems, IoT architecture
Currency	Payment services, internal currencies and utility tokens.
Financial Services	Asset management, investment trading and crowdfunding.
Proof-as-a-service	Notaries, registers and attestation, supply-chain management
Property and Ownership	Digital rights management, copyright and ticketing services.
Identity Management	Self-sovereign digital identity, and authentication
Governance	Voting services, distributed autonomous organisations (DAO).

Figure 22: A typology of blockchain applications (Adapted from Elsden et al., 2018).



Everledger (diamonds)

Everledger Diamond is a platform that offers verification of diamonds along its supply chain. Using different techniques the diamond is 'mapped' after which the data is placed on a blockchain. As a result buyers can be more certain that the properties of the diamond that have been registered have not beel altered.

Agora (voting)

Agora offers both nations and organizations the ability to run a 'decentralized' digital election by using their own VOTE token. Participants get or buy tokens which they can spend on the outome or party of their preference. The platform offer more certainty of a correct tamper-free outcome than counting votes by hand or using a voting machine. Next to this to this it reduces paper costs.

TradeLens (shipping)

IBM and Maersk partnered up to develop a blockchain platform that provides stakeholders (e.g. shippers, freight forwarders, terminal operators, customs) access to a shared view of shipping data (e.g. temperature, weight, arrivals) and documents. The system is supposed to prevent document errors and reduce transit times.

BLOCKCHAIN COMPONENTS

To get a sense of what someone is confronted with when interacting with 'a blockchain'. All components contribute to trust in blockchain technology, depending on how they are signaled to a user (see figure below).

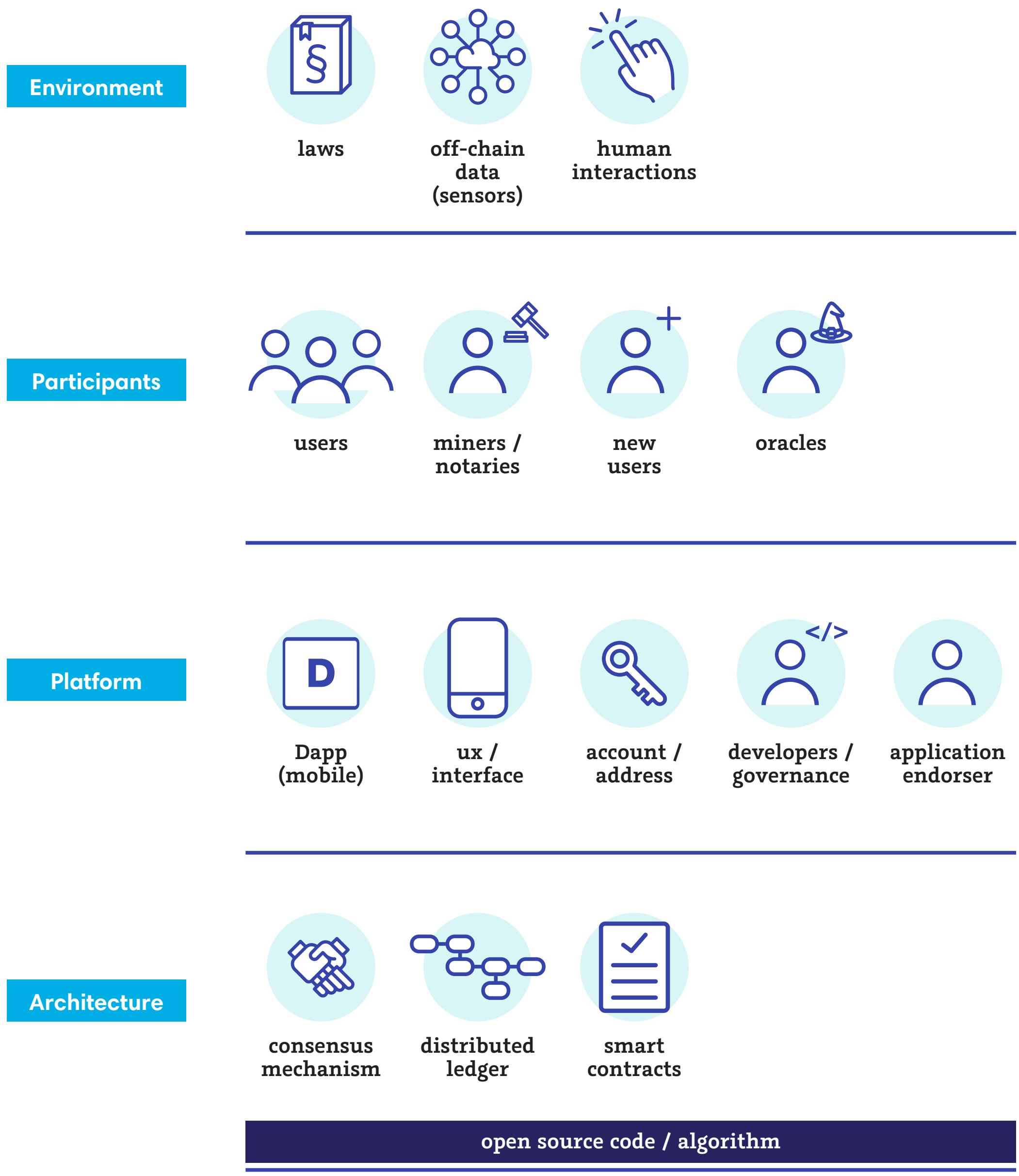


Figure 23: Overview of blockchain components that a user is confronted with.

BLOCKCHAIN IN SOCIETY

Similar to the internet, blockchain technology is infrastructural and thus hard to see or grasp. Following the 'cognitive' trusting base from chapter 2, where trust is build by second-hand knowledge and reputation, it is interesting to discuss the known limitations and societal narrative of the technology.

Technical limitations

Malicious actors can manipulate information on a blockchain by accessing 51% of all processing power in the network.[111] The objective trustworthiness of a network is thus influenced by a network effect: more validating power nodes mean a decreased chance of such an attack occurring.[112] Following the 'calculative' trusting base from chapter 2, it might be that information about the amount of validating nodes influence a user's trust in the ecosystem. Similarly, bigger public blockchains might have a larger developer base who are eager to fix any vulnerabilities that come up. On the other side, these developers are also 'human' meaning that coding errors in the protocol or smart contracts might occur.[113]

Blockchains rely on cryptographic security which, similar to current internet transaction security systems, might become vulnerable to increasingly available computer power (e.g. quantum computing).[114]

The proof-of-work consensus protocol requires heavy computation power and thus electricity. It has therefore been criticized for not being futureproof (e.g. VISA uses an equivalent of 50.000 US households to process 350 million transactions, Bitcoin would only be able to process 6,250 transactions[115]).

Blockchain's experience and ux

Similar to the internet, Blockchain can be reached through multiple interfaces. The most direct way to access a blockchain is by **running a full node** on your own PC. This means that you become an active peer in the network and receive the full history of the available ledger and can verify previous transaction. This requires quite some computer literacy to complete. A less direct way is by using a **third-party browser** (e.g. MIST) to connect to blockchain applications or **plug-ins** (e.g. MetaMask) which can be used on any existing browser. Here passwords are also stored locally on the user's PC. Another common way is by using a **third party crypto wallet** (e.g. Coinbase) where the third party will communicate the transaction to the blockchain miners. However, platforms like these are similar to banks and could potentially control a users' assets. Next to this **applications for mobile/pc** can act as user interfaces for DAPPS (decentralized apps) which run on a certain blockchain (e.g. DATUM). For most public blockchains users can view the **source code** or view the **transactions online**. Finally, a **physical wallet** can be used which only connects to the internet when making transactions (see figure 24 on the next page for an overview).

From a user experience perspective in public blockchains technical challenges include the amount of transactions allowed per block and the speed at which these update.[116] Also, the size of the major public ledgers that need to be downloaded in order to participate as a node can grow significantly, so ways of minimizing this are being sought after.[117] In some permissioned blockchains parties only see data and transactions that involve them personally.[118] This begs the question whether not seeing everything that is happening in the ecosystem will create more or less trust in it. Public blockchains might be attractive for being 'fully transparent' but also be rejected for this same fact.

The immutability of a blockchain makes that any completed transactions can never be undone. From a user perspective this means that the person is in full control but also fully responsible for their own actions. There is no central party that could redo a transaction.

111. Swan, M. *Blockchain: Blueprint for a new economy*.

112. Werbach, K. "Trust-less trust.".

113. Ibid.

114. Ibid.

115. Kobie, N. "How much energy does bitcoin mining really use. It's complicated." *WIRED*. December 2, 2017. https://www.wired.co.uk/article/how-much-energy-does-bitcoin-mining-really-use

116. Yli-Huumo, J., D. Ko, S. Choi, S. Park and K. Smolander. "Where is current research on blockchain technology? – a systematic review." *PloS one* 11, no. 10 (2016)

117. Schoedon. "The Ethereum-Blockchain size will not exceed 1TB anytime soon." *Medium*. 2017. https://dev.to/5chdn/the-ethereum-blockchain-size-will-not-exceed-1tb-anytime-soon-58a.

118. Corda. "States". Corda. https://docs.corda.net/key-concepts-states.html#the-vault.

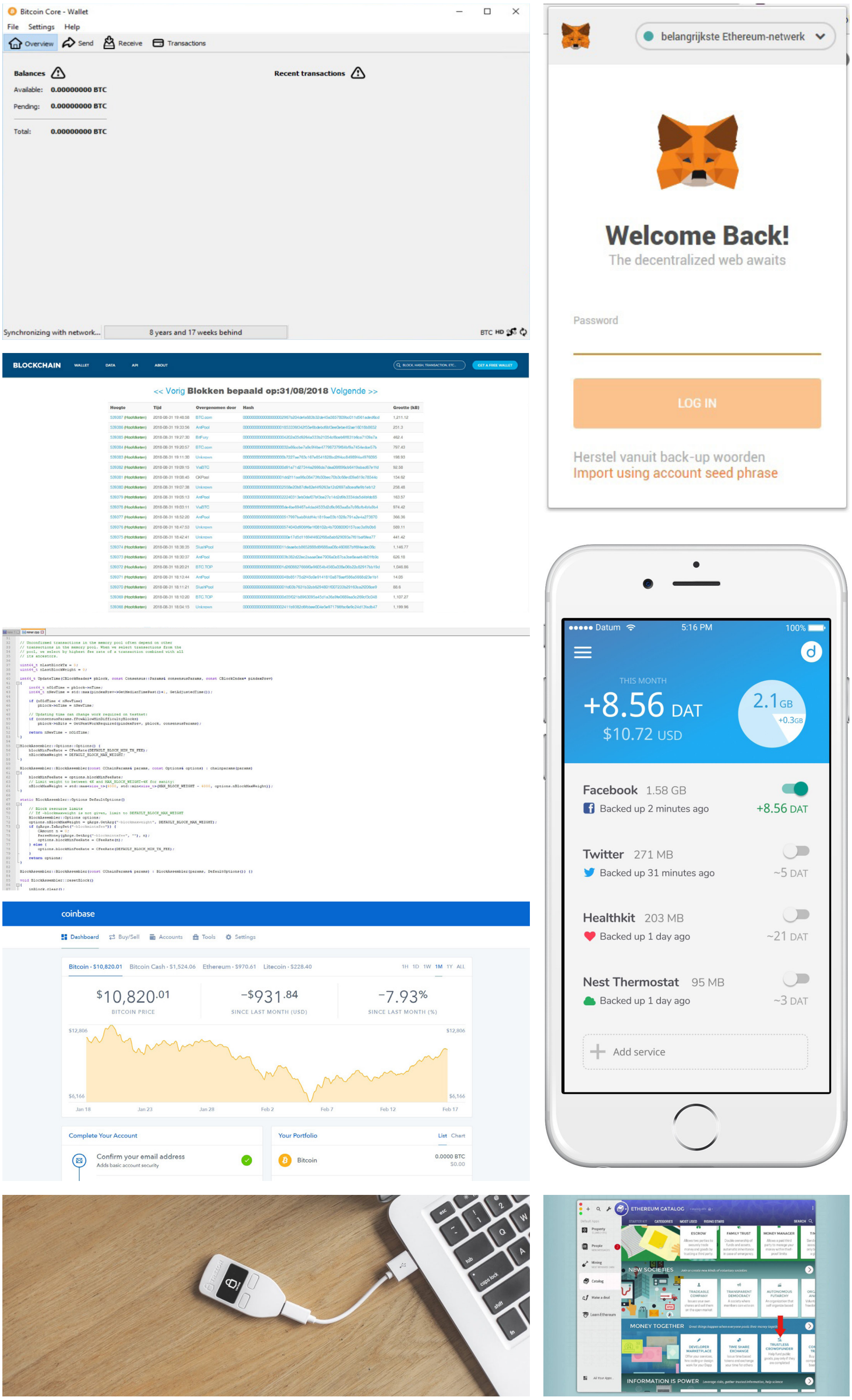


Figure 24: Overview blockchain access points. a) Bitcoin full node client, b) MetaMask browser plugin, c) online Bitcoin ledger overview, d) DATUM mobile application, e) Bitcoin source code, f) Coinbase online wallet, f) Trezor physical crypto wallet, g) Ethereum dAPP browser.

Blockchain's narrative

Events in society can influence how people view a certain technology and form the 'second-hand' knowledge that people carry along. According to Guowei Jiang, a PhD student at the University of Delft focusing on blockchain technology (personal conversation, see appendix B), blockchain technology is suffering from a 'bad narrative' that surrounds it. Jiang points out that it seems two sided: on the one hand limitations, major scams (see figure 25) and BITCOIN rule the narrative of blockchain technology. On the other hand it is seen as a technology which will 'fix everything'. This view fits with the current hyped status of the technology on Gartner's Hype Cycle (see figure 16). These narratives may influence clients to be either skeptical about the technology or come in with high expectations. Both of these could result in a certain overtrust or distrust (see chapter 2).

Cognizant should be aware of this narrative that the technology has in the public, but also what previous experience new clients might have had with the technology (anything from active participation to passive information they received from colleagues/friends/competitors). From a distrust perspective it is also important to first identify and remove reasons why a client might be skeptical about the technology before moving into the benefits of the technology.

Finally, with designing for justified trust in mind, it is helpful to mention boundaries of the technology, things which the technology is not capable of on its own (e.g. checking incoming off-chain data streams).

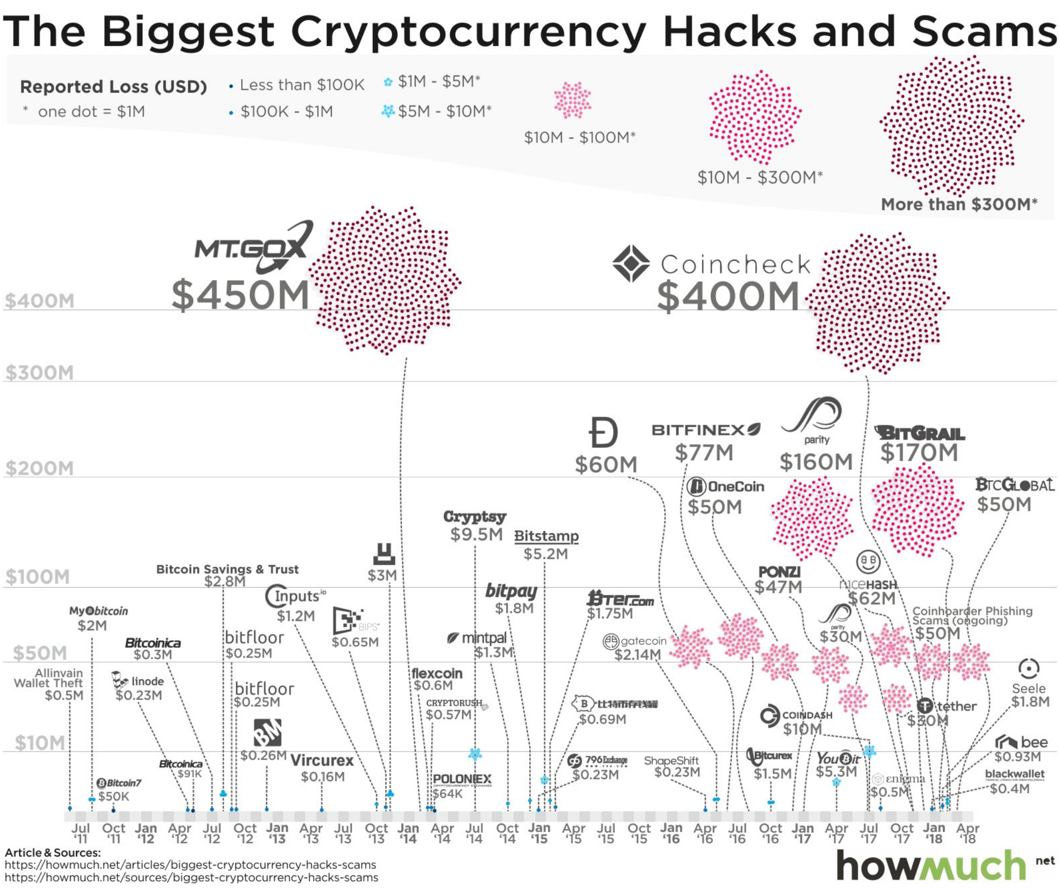


Figure 25: Overview of the biggest cryptocurrency scams since July 2011. Taken from howmuch.net[119]

119. Raul. "The Speed of Crypto Hacks is Picking Up: This Month Alone Thieves Stole $71.5M. *howmuch.net*. June 19, 2018. https://howmuch.net/articles/biggest-crypto-hacks-scams

CONCLUSION

Blockchain impacts the way people will exchange value with one another. It can replace a third party middleman with a decentralized system that runs on principles such as economic incentives for miners, consensus protocols and distributed databases. Some limitations affect the trustworthiness of a blockchain system so smaller private blockchains with only a few participants have a higher chance of being subject of a 51% attack. For clients' organizations who wish to interact with users on sensitive data (e.g. medical records) this can be an important choice. For example, it is still unknown what the balance is between sensitivity of data and the kind of blockchain users demand.

There is a great distance between the UX side and the real technology which might make it hard to say to a client 'now you are using a blockchain, now you are not' let alone have the client experience this. This in contrast to VR where this is directly visible. If the goal is to build trust in a technology, trustors need to know when a technology is supportting them and when it isn't.

Now that a good understanding of blockchain's key components and applicability has been established, the next chapter will theorize on how trust building relates to blockchain.

IMPACT ON DESIGN CHALLENGE

Many components make up the trustworthiness of blockchain ecosystem. These relate to economic incentives and coded algorithms so communicating all of these to target users could make a conversation very technical. However, this might be necessary to build justified trust. For this project it could be interesting to find a way of communicating this without it becoming technical or complex. Many complex elements in our lives have eventually been turned in socialy accepted ways of representing them (e.g. wifi signal bar, organic food label) and it might be that blockchain needs a similar representation.

Blockchain is a very supportive technology and thus allows for a broad range of applications. Next to this, Cognizant consults to clients in very different industries. Designing for trust is domain specific so to maintain a feasible scope for this project it will be best to choose one of the impacts that technology brings and target that. This choice will be made based on the next three chapters.

Blockchain is always implemented in a group setting. Although exchanges happen amongst each other, the trust relationship is with the technology itself. The design solution should thus allow a group of peers to foster trust in a common system.

TAKEAWAYS FOR COGNIZANT

Steer the narrative

Cognizant consultants should take time to establish a strong narrative that goes beyond the cryptocurrencies but does provide a realistic view on what the technology is capable of.
As not many blockchain applications are accessible, there is a great chance that clients have not had a lot of experience with the technology before. For this reason it is key to identify what their 'second-hand' knowledge and narrative is and steer it towards a narrative that fits the project (e.g. have all participating clients write down their perspective on the technology at the beginning of a project). Also indicating the limitations and defining what blockchain cannot do helps in establishing the right trust.

chapter 4
Understanding blockchain's trust paradox

Blockchain technology is often referred to as being 'trustless', inferring that users don't rely on trust for successfully completing an exchange[120]. As the goal is to design for trust in the technology, it is interesting to see if, why and where trust is needed for this specific technology.

120. Nakamoto, S. "Bitcoin: A peer-to-peer electronic cash system." (2008).

TRUST THE TRUSTLESS

Chapter 2 described how individuals need to cross an uncertainty distance through a combination of trust and enforcement. The self-enforcing characteristics of smart contracts and the distributed consensus mechanism would indicate that transactions on the blockchain are completely ruled by enforcement and no trust is needed. However, trust must still be placed in the system[121,122]. A study done on the adoption of blockchain technology for the sharing of electronic medical data also showed that trust plays a significant role in the adoption of the technology[123]. Limited research has already argued for elements that create a need for trust when dealing with blockchain:

Computer literacy

Many blockchain projects are open source, allowing users to view the code that runs in the back-end. However, the low computer literacy of many people withhold them from being able to understand what is happening, therefore forcing them to trust code developers to write the right code,[124] involve a third party to interact with the ecosystem (e.g. Bitcoin wallets) or trust the information that is provided by the application provider.

Governance uncertainty

Many permissionless blockchain protocols are still undergoing updates to increase its performance (e.g. speed/size of transactions). Most protocol providers have a team of developers that propose changes to the network, where miners can democratically vote on whether the change will be set forward. An individual is thus not (always) in control of what changes will be applied to the underlying blockchain protocol.

Human interaction with system

Although deterministic smart contracts are meant to prevent entitites from 'gaming' the system, blockchain systems that incorporate physical artefacts still deal with human interactions. Human interactions are still prone to making mistakes (willfully or by accident). Blockchain can register any pre-determined data points but not directly influence the behavior of people.

On-chain vs. off-chain

Consensus mechanisms can check whether transactions on the blockchain are valid. However, part of the input for smart contracts can be external data (e.g. weather, RFID scan, app interactions) which cannot be validated on the blockchain. Participants in a blockchain system need to trust that this external data is actually 'correct' or 'true'. A solution to this is implementing an Oracle which is a trusted third party that provides this data to the ecosystem. Next to this the balance between off-chain and on-chain data might influence the perceived trustworthiness of the system.[125]

Self-confidence

Part of the power of blockchain comes from allowing people to control their own assets digitally. However, with this power comes responsibility. For example, when transferring

121. Swan, M. *Blockchain: Blueprint for a new economy*.

122. Christopher, C. M. "The Bridging Model: Exploring the Roles of Trust and Enforcement in Banking, Bitcoin, and the Blockchain.".

123. Wanitcharakkhakul, L. and S. Rotchanakitumnuai. "Blockchain Technology Acceptance in Electronic Medical Record System.". 53-58.

124. Christopher, C. M. "The Bridging Model: Exploring the Roles of Trust and Enforcement in Banking, Bitcoin, and the Blockchain.".

125. Elsden, C., A. Manohar, J. Briggs, M. Harding, C. Speed and J. Vines. "Making Sense of Blockchain Applications: A Typology for HCI.".

bitcoins to another address, there will be no third party that can help in case of an address error. Similarly, losing a password to a private account will never be recovered by any other party. For this reason trusting oneself might become more important.

Cryptocurrency valuation

Although we might not notice it, each time we exchange an item for money we trust that this money is worth something to other people we might want to exchange it with in the future. The same form of trust also applies to Blockchain's cryptocurrencies. However, where there are 'only' 180 regular currencies,[126] there are already more than 1700(!) cryptocurrencies (see figure 26).[127] This list is still growing as these coins are a way of incentivizing miners to keep the different blockchains running (see 'Consensus mechanisms' in chapter 3) and invite people to invest in startups. Although all coins are interchangeable through online exchanges, users still have to find a way to determine whether a coin will hold its value. For Cognizant this means that when a client wants to introduce a new permissionless blockchain with an accompanying coin, potential users need to be offered ways to turn skepticism into trust. Where tech-savy crypto enthusiasts will be updated through group Telegram chats[128] on what (not) to buy, new users might need to be given other handles.

126. Travelex. "Current world currencies." *Travelex*. https://www.travelex.com/currency/current-world-currencies

127. CoinMarketCap. "All Cryptocurrencies." *CoinMarketCap*. https://coinmarketcap.com/all/views/all/

128. Griffith, E. "The Hustlers Fueling Cryptocurrency's Marketing Machine." Wired. June 12, 2018. https://www.wired.com/story/the-hustlers-fueling-cryptocurrencys-marketing-machine/.

129. Bracamonte, V., H. Okada. "The issue of user trust in decentralized applications running on blockchain platforms.". 1-4.

Nr	Name	Market Cap ($)
01	Bitcoin	119.426.806.867
02	Ethereum	28.443.291.677
03	XRP	13.108.279.928
04	Bitcoin Cash	9.250.157.321
05	EOS	5.310.967.579
06	Stellar	4.066.547.115
07	Litecoin	3.494.654.363
08	Cardano	2.576.257.873
09	IOTA	1.896.173.076
10	Monero	1.603.434.735
11	TRON	1.574.201.961
12	Dash	1.492.331.145
13	Ethereum Classic	1.337.254.821
14	NEO	1.234.253.243
15	NEM	915.964.314

Figure 26: Top 15 cryptocurrencies based on market cap value. CoinMarketCap.com

WHO IS THE TRUSTEE?

One of the key unanswered questions with regards to trust and blockchain technology is "who is the trustee". Currently in many exchanges trustors are used to building both trust in the other person/organization with whom an exchange should take place and in the control system that mediates this (see chapter 1). Blockchain technology seems to require people to stop trusting the other and solely trust the control mechanism. Rather than providing information about the trustee (like reviews), blockchain systems focus on providing a trustworthy control system which is inherent to the technology. For technologies such as Microsoft Excel or a car navigation system, people are more used to placing trust in the technology because it involves an individual and the technology. However, blockchain applications naturally involve many different parties, which seem to be put on the sideline.

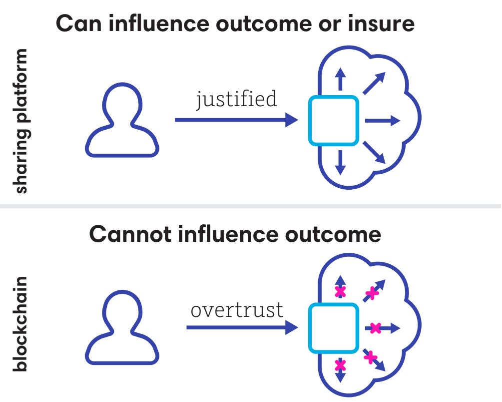


Figure 27: Institutional based trust in blockchain is misplaced.

Institution-based trust

Even though blockchain technology can operate without the need for a third party and is not owned by a single entity, it is not clear yet to what extend the users' perceptions of the developers and organizations that introduce a decentralized platform will affect the formulation of trust in the technology.[129] Although blockchain can be classified as a technology which is low in humanness, it is unclear whether users will form social trust towards the developers or more technological trust towards the technology itself.

One study done on trust in Uber found that users place their trust in the company Uber rather than the drivers. So even though trust is built decentrally in drivers, users still seek for a central entity to place their trust in (something which, according to chapter 2, is slightly contradictory to Edelmans barometer results). However, the same could happen in a blockchain ecosystem. The difference being that Uber is able to insure people when things go wrong, in a blockchain environment participants are 'on their own' which means that placing trust in any central entity (e.g. the company that promotes the blockchain) would be an act of overtrust (see figure 27, previous page). Because users need to access the blockchain through some form of UX, some blockchain companies distantiate themselves from the technology (see figure 28). It is still the question whether users will adopt such a statement immediately or fall back on the central entity. On the other side, a central entity or brand that promotes a certain blockchain ecosystem could help to engage people and stimulate them to take that 'leap of faith'. An institution that is part of a system could (not necessarily!) tell a user something about the potential build quality of the system he or she is engaging in.

130. Werbach, K. "Trustless trust.".

131. Ibid., 37.

132. Ibid., 46.

133. Botsman, R. "Thinking.". Rachel Botsman. https://rachelbotsman.com/thinking/

133. McDonald, A.M. and L.F. Cranor. "The cost of reading privacy policies." ISJLP 4 (2008): 543

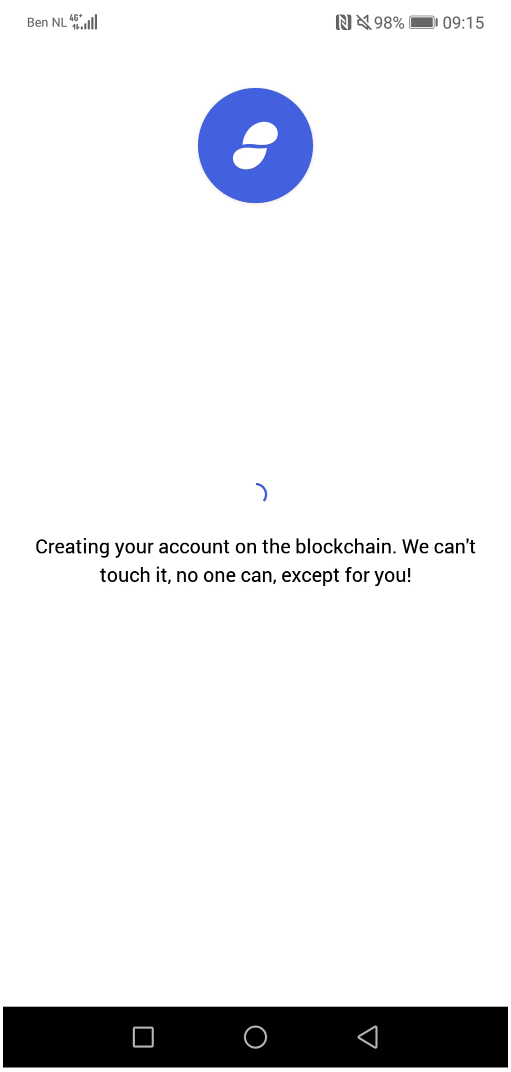


Figure 28: Account creation in DATUM app.

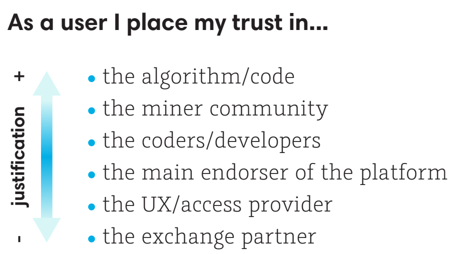


Figure 29: Hypotheses for blockchain's trustee

COMPLETE NEW FORM OF TRUST

Werbach[130] attempted to describe the new 'trust architecture' which blockchain technology brings. The author states "to accept a blockchain transaction as valid is to trust the system it's based on, without trusting any participant in it.[131]". As described in the previous paragraphs trust seems to not really be institutional nor peer to peer. Participants have to place trust in a collection of components (cryptography, open source code and mining protocol). A blockchain could almost be seen as a "collective entity",[132] like a company, which is also capable of evoking different forms of trust. Although aimed at sharing platforms, Botsman uses the term 'distributed trust' which is build by networks of people, organizations and technology. Maybe in this new form of trust people will be able to perceive multiple components/people as a trustee at the same time. Some hypotheses for who the trustee will be are shown in figure 29.

NOTE: In a smaller permissioned blockchain, where the chances of a 51% attack are higher and other peers are identified and known, trust will most likely be placed in all participating peers. The justification of this will depend on who is in charge of validating new transactions.

Transitioning phase

People have already experienced a shift in trust (see chapter 1), but it will take time before they get used to this new form of trust. For example, if there are multiple different blockchains running in parallel on the web, what is it that makes a blockchain perceived as trustworthy or not. For companies this might be a marble building. For the internet this translated into the quality of websites, brands and peer reputations. Blockchain is still looking for these 'socially accepted' elements.

Besides the previously mentioned issues of institutionally based overtrust, the transition to blockchain trust might bring other problems. For example, People already overtrust internet services (e.g. it takes an average american 201 hours to read all privacy policies he or she encounters[133] thus accepting them immediately is easier) but the outcomes often deal with information. For a blockchain however, smart contracts deal with real value so directly accepting a use policy from a certain company might have a major (negative) impact.

Blockchain stimulates distrust

On a personal philosophical critical note: Blockchain essentially assumes distrust amongst peers and tries to shift the trust to an algorithm and consensus mechanism. There have always been human value exchanges where inserting a third party middleman is too expensive and thus personal relationships had to be build. However, building and coding a blockchain will only become cheaper. If the availability and accessebility of blockchains grows, more and more of these exchanges amongst people might move to this algorithm realm. People might demand blockchain technology for all sorts of interactions. As a result, an increasing amount of distrusting relationships could start to emerge. For example, research has indicated that enforcing human relations through contracts can stimulate the negative effects of distrust and gives people no human trust to 'fall back on' when contracts aren't there.[133] Next to this, trust in other people and governments has shown to be a predicting factor of "societal stability and quality of life"[134]. From a human-centered design perspective it might thus sometimes be worth the question: why do people not trust each other and is there a way to establish this trust in a human way. Maybe blockchain isn't always necessary or even such a good idea.

133. Lumineau, F. "How contracts influence trust and distrust." Journal of Management 43, no. 5 (2017): 1553-1577.

134. Diener, E. and M.E. Seligman. "Beyond money: Toward an economy of well-being." Psychological science in the public interest 5, no. 1 (2004): 3.

CONCLUSION

Many components make up a blockchain but in a similar way many components make up a company. We have learned to trust companies based on certain identifiers. A blockchain platform is not an established company and it is still unclear who will be the target of trust. Also, users will look for cues of what to trust and how to correctly place trust.

IMPACT ON DESIGN CHALLENGE

A lot is still unknown about what makes people trust certain blockchains or not. Some design directions arose from this chapter:

Designing for justified trust seems all the more important in the transition phase of getting used to working with blockchain systems. Users and clients will most likely bring their 'old trust beliefs' with them and value instititional trusting bases or reputations. Whereas this really would be misplaced trust. The final design activity could focus on teaching or steering people towards this new form of trust and make them acquainted with it.

Although some research has been done into this, it would be interesting to see for different kind of blockchain systems who the users perceive as a trustee. Even more interesting would be to find out what kind of elements would nudge users towards other trustees (e.g. would information about the amount of miners influence this). This could give Cognizant some ideas for how to communicate to users around a blockchain.

From a design perspective it might be interesting to look at a way of communicating to people what it is they are committing to when engaging with a smart contract. Although this will be more focused on the final UX design, it could stimulate adoption.

TAKEAWAYS FOR COGNIZANT

Use trust elements as boundaries

The elements where trust is needed may be a useful base for indicating the boundaries of blockchain technology in the narrative towards clients. Technology adoption by clients is often a consideration between risk and benefits, so providing a client with these boundaries might help them in making a justified choice. The elements could especially work for clients who perceive blockchain as a technology that can solve everything through code but who do not necessarily want to be overwhelmed by the technical specifications to understand it. The components can also be seen as considerations for designing a new blockchain platform.

chapter 5
Blockchain through the eyes of clients

To better grasp the interplay between 'blockchain technology' and 'trust' in the context of Cognizant's business, a case study was performed for an ongoing project. This made it possible to step into the shoes of a client and see what they experience when confronted with this new technology. It shed some light on the practicalities of setting up a blockchain ecosystem; something which seems to be underexposed in literature[135].

135. Hawlitschek, F., B. Notheisen and T. Teubner. "The limits of trust-free systems: A literature review on blockchain technology and trust in the sharing economy." Electronic Commerce Research and Applications 29 (2018): 50-63.

CASE

Over a 10 week period different workshops, meetings and presentations were attended at the client's office. Discussions were held with numerous employees from both Cognizant and the client, but no formal interviews were executed. During the observations the key focus areas were: (initial) reactions to blockchain technology and trust challenges that occurred in practice.

Cognizant's client was a multi-national sporting shoe and apparel brand (hereafter referred to as the 'Shoe Brand') which had been running multiple blockchain experiments in parallel. However, the particular employees who participated in this usecase did not have any previous experience with blockchain technology. According to the project lead of the Shoe Brand, the goal of the project was as follows:

Find out whether blockchain technology can bring any new capabilities that would or could not be achieved with other technologies.

In order to proof this, a specific usecase was being worked out called the 'shared inventory case' (see figure 30). For more detailed information on the case study planning, observed activities, Cognizant team, process, client and usecase please see Appendix C.

RELEVANCE

The usecase deals heavily with the topics of 'trust' and 'blockchain'. Retail brands and wholesale players normally don't exchange specific (inventory) information amongst each other due to their competitive relationships. Since all players are competing for similar consumers in a saturated market, the risk of the other party potentially misusing the information is higher than the perceived benefits of sharing the information. The inventory related services which are currently shared, are often operated with the use of a third party (e.g. Anatwine) and a team of lawyers. One could say that there exists a two-side relationship: they need to trust each other to sell shoes but distrust each other due to the high competitiveness. Blockchain technology could potentially reduce risks and enable new interactions. Next to this, the newness of the application of blockchain for the Shoe Brand made it interesting to see how trust plays a role there.

KEY INSIGHTS

During the case study and the analysis, some key insights could be derived. Insights relating to trust in technology and/or blockchain technology were kept. Insights about retail service design, the retail industry or company were excluded.

Figure 30: Storyboard and concept of the project that was studied during the case study

Going onto the blockchain can be scary, even when you initiate

Although the Shoe Brand was the initiator of the blockchain concept and would in a next phase be the party that proposes the concept to other wholesale partners, not everyone at the Shoe Brand was immediately open to the company joining such a blockchain system. During one of the workshops one of the key technology leads raised the questions about sharing inventory data:

Are we ready to open the kimono and ready to show what we have?

This is interesting because the blockchain concept was designed in such a way that other peers would only be able to see very little information to ensure the privacy of all parties. In that sense, the Shoe Brand would not even need to show that much information about itself.

No trust that blockchain technology can impact the real world

One of the biggest trust issues seemed to be with the ability of 'the blockchain' to impact human behaviour. In the initial concept a runner would check into the BOH of another wholesaler and take the shoe autonomously to make the flow as smooth as possible. Eventhough all interactions (e.g. logging in, checking in, taking a shoe) would be registered onto the blockchain automatically and make the runner directly accountable, some employees did not trust someone to just 'go into another BOH'. It seemed that for this specific element, employees place their trust in the people rather than the technology. This is in line with the prediction from chapter 2 that blockchain technology cannot directly influence human behaviour.

However, as a result of this distrust, the team decided to include a wholesale BOH employee to help with handing over the shoe to the runner. This will make the concept more costly to operate, less reliable and especially miss out on opportunities which the blockchain could potentially bring.

Setting up smart contracts is already a risky undertaking

As the Shoe Brand and wholesalers have a distrusting and competing relationship, the team had to consider that parties will do anything to game the system. This meant that the rules in the smart contracts have to prevent all possible scenario's. Some examples to illustrate:

- Party A buys less original stock from the Shoe Brand and only requests it from other stores to minimize personal warehousing costs

- Party A could send 100 people to the store of Party B and request many shoes which are known to be available at Party A. Party A can sell its' stock without waiting for 'real customers'.

- Parties buy only one size of original stock from the Shoe Brand and request other sizes.

Blockchain requires these partners to get closer and although it 'takes care of everything' once it is setup, parties first need to discuss the rules. These often come closely to how different retailers/ wholesalers execute strategies within the retail domain. One employee put as follows:

Wholesalers now have to open up about how they want to play this game.

»

Joining parties need to be trusted for the data they bring

During the visit to the retail store it became apparent that getting reliable inventory data is hard because a shoe can be in many places or even stolen, without the shop owner knowing this (see figure 31). For this reason it is hard to get complete accuracy of inventory data. Blockchain can influence the correctness of transactions happening on chain, but cannot influence the accuracy of this external information. Parties still need to trust that onboarded partners bring correct data. This correctness will influence the trustworthyness of the whole blockchain ecosystem, especially when the system relies heavily on this data and the risks are high (e.g. telling a consumer a shoe is not available after first saying it would be is worse than selling 'no' the first time).

Figure 31: Low inventory data reliability due to numerous unplanned locations of shoe

People tend to think in old trusting concepts

During the case study it sometimes seemed as if employees did not always fully understand the value of the technology. One employee stated:

If that level of trust exists, I wouldn't need blockchain.

What's interesting about this quote is that somebody captured the essence of blockchain's value proposition without realizing it. It is because one doesn't have that level of trust in the other that blockchain is needed. In this case trust still seemed to be placed in the other entity. Another, more technical, observation was that there seemed to be a preference for having a third party be responsible for validating the transactions on the private blockchain rather than choosing the possibility to decentralize this across the retail peers. This was partly due to the selection of the framework but also because maybe retailers are used to involving a third party when transacting with other 'competitors', refering back to more 'institutional trust'.

It is hard to grasp or experience the real value of blockchain

Looking at the different ways in which the blockchain technology was 'communicated' towards the client (see figure 32 & 33) it becomes apparent that many forms try to bring across knowledge about the functionalities or value in a more passive way. For example, powerpoint slides with a summary of the key values of the technology or the actual blockchain code running on four large screens to show what is happening. The first actual interaction with the technology occurred near the end of the project when the mobile application, which ran on a fully working blockchain, was being built. However, with such an application it is still hard to really experience where the blockchain is supporting the interaction. For this reason a supporting movie was created that explains how the blockchain technology supports this specific concept.

Since blockchain is such an infrastructural technology, it seems hard to make people truly experience its value in an interactive way (top right corner of figure 32). Contrary to technologies such as VR and AR, where the possibility to experience it is more inherent to the technology.

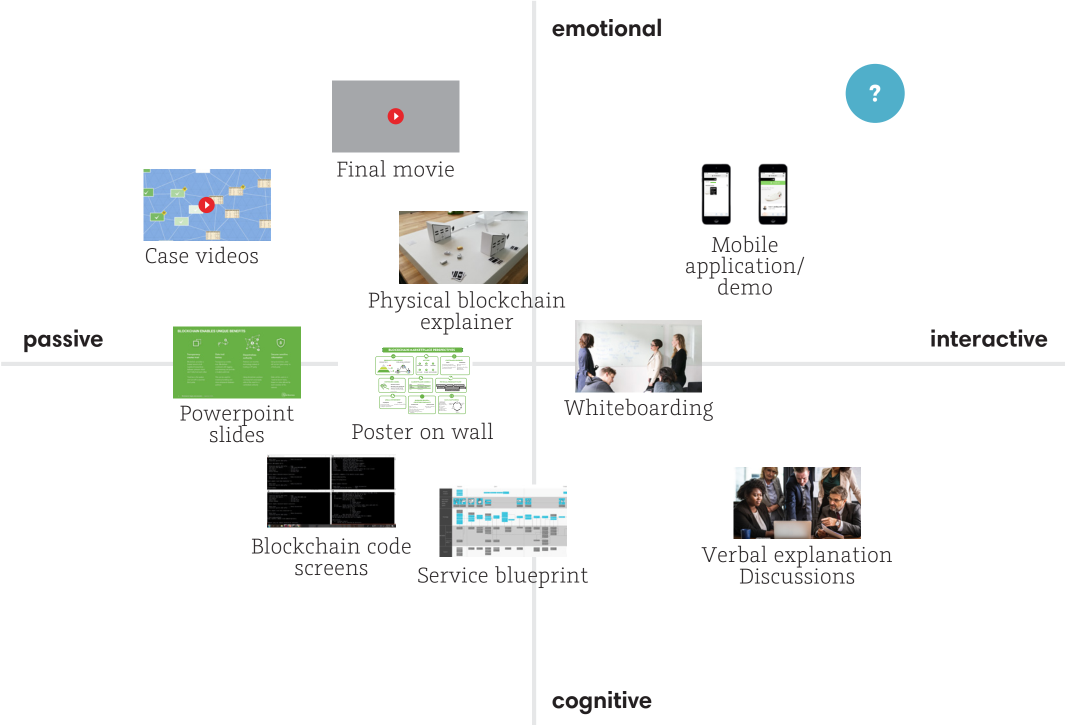


Figure 32 Formats used for communicating about blockchain technology plotted on Passive/Interactive and Cognitive/Emotional axis

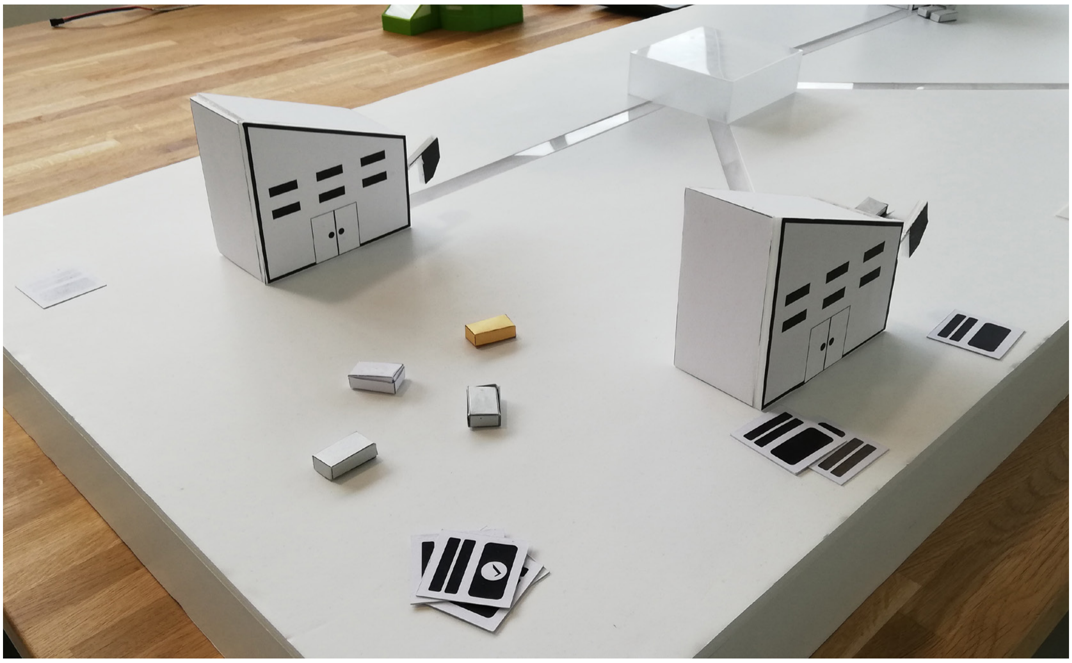
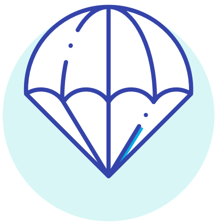


Figure 33: Picture of physical blockchain explainer used at the beginning of the case study project.



Blockchain brings new and uncomfortable interactions

During the end-demo at the Shoe Brand, the discussion amongst a VP and directors focused heavily on the new trust paradigm that blockchain technology unlocks. Employees seemed to trust the shared inventory concept but expressed thoughts with regards to the new way the blockchain would require partners to cooperate. Employees talked about "shared risk", a "culture shift", the Shoe Brand having to "open up" and 'giving away trust at the right time'. Continuously wondering how to get the wholesale partners to this level of thinking. It might be that the challenge isn't in making clients trust the usecase or specific technicalities, such as 'storing data', but rather the new way of interacting that it brings.
In these competitive markets, companies are used to involving a 3rd middlemen-like parties because the sensitivity of the concerning information makes it 'scary' to interact with partners directly. Blockchain opens up a world of interactions that might be out of a company's comfort zone. Providing clients with an experience that allows them to start interacting with others using this new trust paradigm could be a way forward.
This discussion also shows that applying or using blockchain technology is not a 'one-man-show'. The fact that it's an infrastructural technology supports this (see chapter 3). Besides public blockchains where applications can be deployed and operated by a large anonymous group of nodes, private blockchains involve close collaborations with known partners in a new way.

IMPACT ON DESIGN CHALLENGE

Based on the findings above, it seems that the opportunity doesn't necessarily only lie at the user level but also on Cognizant's clients level and how they interact with new technologies. The case study has shown that trusting a blockchain is not just a technical topic but a highly emotional one. The activities that go beyond the protocol are the ones where trust is needed (e.g. bringing in data from partners).

One of the explanations for not building enough of a trust relationship with the technology could be the fact that Proof-Of-Concepts (POC) are executed in a 'lab' environment. This means that the project has less 'weight' to it and can still go into all directions. This is definitively a good thing from an exploring/creativity perspective.However, looking at the TAM model (see chapter 2), POC activities are often aimed at convincing people about the 'ease of use' and 'perceived usefulness'. Focusing some activities explicitly on building trust could boost the adoption of the technology by clients. From a trust in technology perspective the lab setting might mean that clients do not experience (enough) risk and therefore never need to fully trust the technology nor build trust in it.

Also, it isn't strange that clients found it hard to grasp the technology and the impact on relationships it brings. As seen in chapter 4, blockchain brings a completely new trust paradigm. Not institutional, not peer-to-peer. Maybe an activity could focus on providing people a first view or grasp on this change.

Besides, looking at the the tools used during the project that relate to blockchain, it is only untill the end that employees get to engage with the technology through the mobile application. Most of the tools focus on transfering knowledge from Cognizant to the client, which could be seen as 'second-hand' knowledge and mostly contribute to building initial trust. As no direct first-hand interactions with the technology take place, no stronger knowledge-based trust relationship can be established (see chapter 1.3). Although trust is domain specific and the trust build in one interaction might not transfer to another, establishing some knowledge-based trust at an earlier stage might be the key to exploring more opportunities later on.

From a strategic perspective this lack of building trust can be a problem for the phase after the POC when things do become risky. In a call on May 28th, 2018, Tim Smeets stated that clients are often open to doing a POC, but are sometimes anxious to continue for a bigger project after completing a POC. Besides reasons such as not seeing the benefit of the idea or not having a solid business case, it could be that trust in the technology plays a role as well. Being able to increase this trust in technology by clients could help in continuing a project later on.

Cognizant performs many good activities with clients to communicate blockchain technology. However, looking into activities that can make clients have an interactive experience with the technology that accentuates the emotional side could be a way to build the trust in technology even more.

TAKEAWAYS FOR COGNIZANT

Blockchain is a group effort

Projects are often build around a single client. However, blockchain technology requires a network of peers to work together. From a trust perspective it will also only work if all participants trust the system. For Cognizant it might be better to demand the involvement of partners for the setup of a new blockchain ecosystem. Although clients might not always be eager to involve partners early on, it can definitively boost the adoption potential of a project.

Technology vs emotions

Besides being very technical, setting up a blockchain involves a lot of emotions. During the case study it became clear that the new propositions might require the client to work with peers in completely new ways. To support this, Cognizant could create awareness of this fact at the beginning of the project. Next to this add sessions on how to setup an ecosystem with peers or workshop on collaboratively setting up a smart contract. Cognizant could also provide a service where they 'warm up' clients' partners/ competitors of the client for the technology in a right way.

chapter 6

The design brief

In this chapter the design brief will be formulated based on all the insights from the previous research chapters. A design brief highlights the vision and goal(s) of the project and states the key design criteria that should be considered for the final proposal. In a similar way it can be used as a guideline for creative sessions and any ideation.

136. Carson, B., G. Romanelli, A. Zhumaev and P. Walsh. "Blockchain beyond the hype: What is the strategic business value?" McKinsey. June, 2018. https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/blockchain-beyond-the-hype-what-is-the-strategic-business-value

The research showed that blockchain is rather abstract which makes it hard to 'see' or grasp what it can do for someone. Although Cognizant made use of different kind of good activities to showcase the technology, direct emotional experiences seemed to be missing at the start of a project (see figure 34). From a trust-building perspective these experiences might however be necessary to build the strongest trust. Besides, these experiences could have even more impact if they involve some form of risk/opportunity and uncertainty as it forces clients to place trust in the technology.

Chapter 2 and 3 indicated that, also in practice, the major impact of blockchain is the new way it allows peers to exchange value. This does not only impact a client on a technical level but also on an emotional level. Where a company might have been comfortable with having a 3rd party in between themselves and their competitors, blockchain technology brings new forms of one-on-one interactions that are unknown. Competitors have to work together to run a system that allows them to have exchanges which they would normally be anxious about. This is also referred to as the 'coopetition paradox.[136] Still, building trust in a new technology allows someone to explore more opportunities with it, to stretch its' capabilities. If an experience could bring clients to a state where they are comfortable with this new way of interacting with partners that blockchain technology brings, this could benefit the projects later on. The idea is to 'pull' this topic, which in the case study only appeared in the end, to the front of a project The design challenge for this project is:

Offer clients a 'risky' activity which allows them to have an experience with blockchain technology that highlights the new type of relationships.

The goal would be to accelerate trust in the technology at the beginning of a project and get comfortable with this impact.

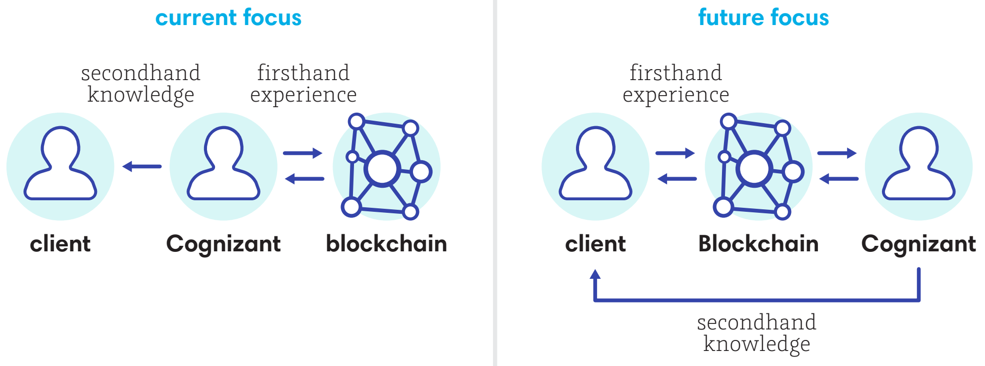


Figure 34: Primary activities focus on passing on Cognizant's knowledge. This project aims to provide direct experiences for clients.

Secondary goal

A secondary goal of the activity should be to develop justified trust. This means that one of the discussions in the workshops should highlight some of the elements that make a blockchain system trustworthy and where the limits are (e.g. amount of validating nodes, who will see the transactions for validation). Having this discussion at the beginning of a project will help clients formulate the right trust rather than basing it on what they heard from someone else (see 'narrative' in chapter 3).

DESIGN CRITERIA

Activity should be for a group setting

The 'coopetition paradox' shows that implementing blockchain technology is not a 'one-man-show'. The fact that it's an infrastructural technology supports this (see chapter 3). For this reason the activity should try to bring together a group of peers (preferably the client and its partners/ competitors).

Activity should be directly for clients

The experience should be directly performed by clients. It should not be something which Cognizant's consultants demonstrate or show.

Activity should involve some form of risk

To make clients trust the technology it would be best if the activity involves some form of risk or opportunity and uncertainty. This means that decisions should be taken for which the outcome is not completely certain. This risk or opportunity should however not endanger clients in any way.

Activity should be experienced individually

Although a group setting makes sense for simulating a blockchain, it's best if the experience is felt by each participant individually. Participants should not rely on each other for engaging with the blockchain or making decisions but rather make their own choices. This places the vulnerability in the individual and not in the group.

Activity should be scalable

During the case study the size of the attending employees from the client varied from a single person (interviews, workshops), to group settings (4-5 people in workshops, open house etc.) and larger audiences (10-15 people in presentations, milestone meetings etc.). From Cognizant at least two employees were present in all the sessions. As the experience should involve a group of people, and the size of this group can change, it might be good to create something that is also scalable. As Cognizant deals with different kind of clients it would be beneficial if the experience can be applied in a range of industries.

Activity should have no central entity

To provide the 'right' experience, the activity should allow players to build trust collectively and not through a single entity. This means that it should only work if the players work together.

chapter 7
Experiencing new technology

From the previous chapter it became clear that Cognizant could benefit from offering clients an experience of blockchain technology at the beginning of a project or in a workshop format. However, this challenge is still a rather broad one. To scope the design possibilities a bit more, the topic of 'technology experiences' was explored.

By means of a small case study of different technology experiences, a creative session, two short interviews and some literature research (see respectively appendices D/E, F and B), some criteria were setup for what makes a good technology experience.

WHY EXPERIENCES ARE POWERFUL

Presentations often contain abstract representations of things which need firsthand experiences to be understood in the right way.[136] For example, Cognizant's consultants might understand some blockchain concept in a certain way based on their own experiences, but if only offered information a client will interpret this differently based on their own experiences, knowledge and beliefs. This means that their shared understanding of a concept might be different than desired (see figure 35).
Next to this, for one-way presentations audiences have gotten used to paying only "partial attention"[137] and coming and going when they please (which at times also happened during the shoe brand case). In this way the information won't let to conviction or action, which is desirable for both a client as well as Cognizant. However, allowing clients to have their own experience lets them return with not only an intellectual but also an emotional connection to the work, a new shared meaning as a group and the potential to "extend the story to others"[138] which allows for better uptake in an organization.
Erwin describes five different types of experiences (see figure 36).[139] Especially the 'interaction' type is interesting for this project as it is good for building new mental models in experimental ways. This type of experience is often about 'hands-on learning' and physical elements lead to a better rememberance of emotions.

136. Erwin, K. "Communicating the new: Methods to shape and accelerate innovation." *John Wiley & Sons*, August, 2013.

137. Ibid., 151.

138. Ibid., 152.

139. Ibid.

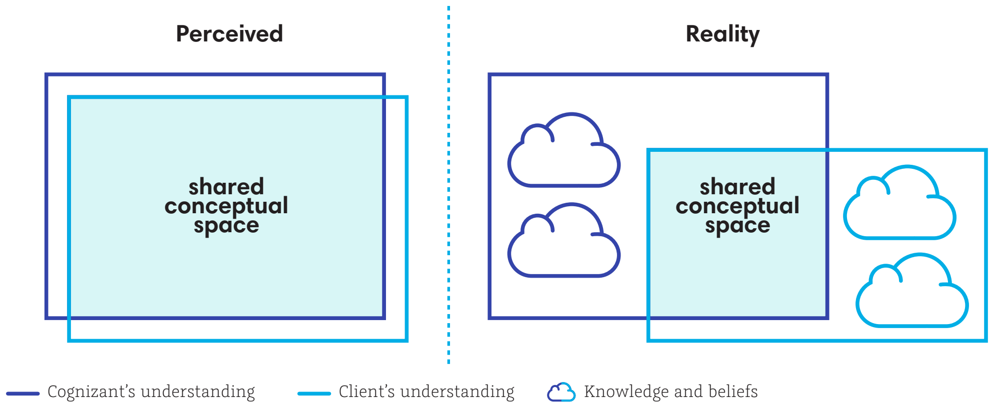


Figure 35: Information transfer and shared conceptual space adapted from Erwin (2013).

How experience models break conventions

	1 Exploratory	2 Immersion	3 Interaction	4 Application	5 Extension
Content	non-linear free-form			self-organizing content	non-linear bite-sized random-access
Materials	3D artifacts, visual and varied in scale	multi-media, multi-sensory propos	3D artifacts, games	artifacts, worksheets	visual artifacts
Interactions	self-directed or small groups		self-directed, tactile, experimental	facilitated	self-directed or small groups
Environment	full-room, large-scale installations	full-stage, technology-aided	stations and work spaces	collaborative work spaces	
Good for...	rich learning spaces for interative, self-paced discovery	simulations of user experiences or proposed experiences	experimental experiences to build new mental models	build familiarity with data via problem-solving	extensive learning experiences to help data go viral

Figure 36: Five types of experiences adapted from Erwin (2013).

BALANCE THE WHAT AND HOW

Holly Robbins, a PhD student at the TU Delft, explained that technologies are becoming increasingly complex and therefore masked to increase the usability for users. As people no longer know exactly what a technology is capable of, they might overuse it. Robbins argues that people need to be involved in the task of the technology, whilst keeping the activity legible for users. For this project that meant finding a sweet spot between showing the 'value' and 'working code'. Based on this different technological experiences where ranked on a scale from their focus on 'what value the technology brings' to 'how it delivers this value' (see figure 37). First some alternative ways of experiencing a blockchain were found, compared to the already existing mobile applications. Next some experiences from different types of applications were found as well. Some experiences focus on showing what a technology can do and some focus on how it achieves this. Examples of the first are Deloitte's AIME and the BitBarista coffee machine. On the other hand, the PwC workshop is almost a one-to-one simulation of a blockchain in a group setting. The problem with purely simulating a technology is that it has no purpose and therefore users might feel less of a need to place trust in the technology. Two experiences that seemed to come close to this sweet spot are the 'Electric charger' and the 'BitExchange' workshop (see next page for an explanation as to why). For more specific information on the technology cases, see appendices D and E.

SHOULD LEAVE A MESSAGE

During the first creative session it became clear that a good experience should leave behind a key message that is surprising, confronting, new or memorable. One way to get there is by clearly having an A/B scenario where people are taken along from the old to the new scenario. Also, if it involves some form of risk it should be a risk that any type of client can feel. Next to this, participants should be able to decide themselves how much risk they would like to take. Finally, the risk should not endanger a client in any way.

This is a design for a charging station for electric cars done by The Incredible Machine agency for ElaadNL and Alliander. By showing how much electricity is available and what is already being used, this station tries to communicate that the electricity net cannot charge all cars in the network at the same time. It reminds electric car owners that they are part of a bigger network that involves other car owners who are also requesting electricity.

In this workshop provided by the university of Edinburgh the focus is less on accurately simulating how nodes in a blockchain network communicate and more on rethinking what value is, its form and how value can be exchanged for other value. A part of the group exchanges value cards whilst a few participants simulate the mining process by executing some mathematical puzzles and adding blocks to the chain.

Cognizant should consider to develop experiences around the different technologies which it is working with (e.g. AI, Blockchain, AR). The book by Erwin provides different types of experiences that might be suitable for different goals. Providing firsthand experiences makes stories come to life and the information more top of mind for client organizations. Even a product end-demo (like in the Shoe Brand case) could be enhanced by having the participants enact the demo rather than only showing it to them.

chapter 8

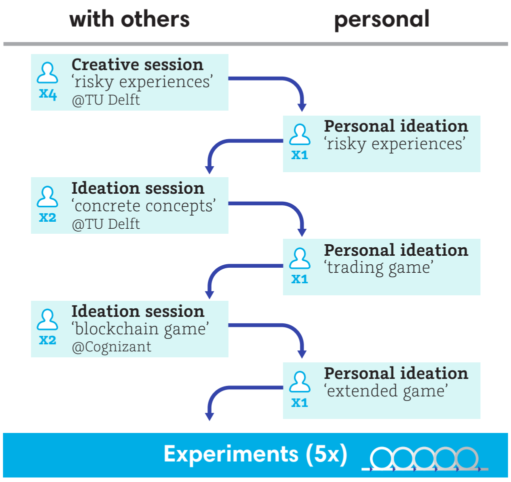
Viral art blockchain game

Based on the insights from the research, creative sessions and four experiment iterations, the game 'Viral Art' was created. After a short explanation on how and why it was created, the game will be explained.

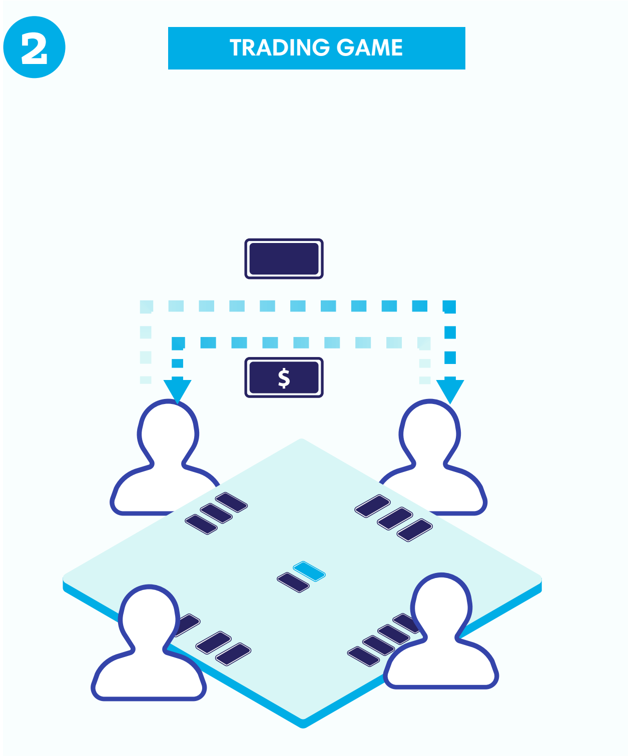
DESIGN PROCESS

After deciding to go for a 'risky technology experience' of blockchain, a creative session was set up. In this session the topics of 'experience' and 'risky experience' were explored. It became clear that translating the design brief into clear ideas was still hard to do in a group. Juggling the concepts of trust, risk and blockchain did not result in many concepts. Two examples of concepts can be seen on the right..

For more information on the setup of the sessions and the insights see appendix F.



Clients bring their own laptop and are able to sell any leftover harddisk space to another user on the web. This concept makes use of the asset tokenization (see chapter 3). The risk is that a participant is giving up something personal (harddisk).



Participants trade and collect items of which copies are in the game. Through three rounds players discover how trusting one another for direct trading is risky, having to pay a middle man for security is expensive and finally how a blockchain helps.

Why a board game

How it was developed

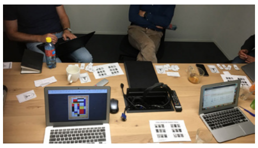
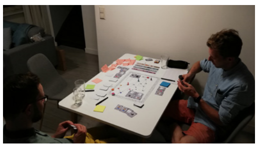
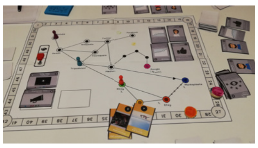
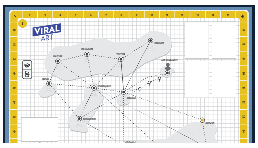
		Goal	Participants	Key decisions
BitArt		**Goal:** Validate concept and check playability	**Participants:** 5x Cognizant employees	**Key decisions:** Add more gameplay and interaction beyond trading
Viral Art I		**Goal:** Test playability and impact	**Participants:** 3x friends	**Key decisions:** Add more gameplay and interaction beyond trading
Viral Art II		**Goal:** Validate concept and check playability	**Participants:** 3x friends	**Key decisions:** Add more gameplay and interaction beyond trading
Viral Art III		**Goal:** Validate concept and check playability	**Participants:** 2x friends	**Key decisions:** Add more gameplay and interaction beyond trading
Viral Art IV (final)		**Goal:** Validate concept and check playability	**Participants:** 4x Cognizant employees	**Key decisions:** Add more gameplay and interaction beyond trading

Figure 39: Overview of different game iterations.

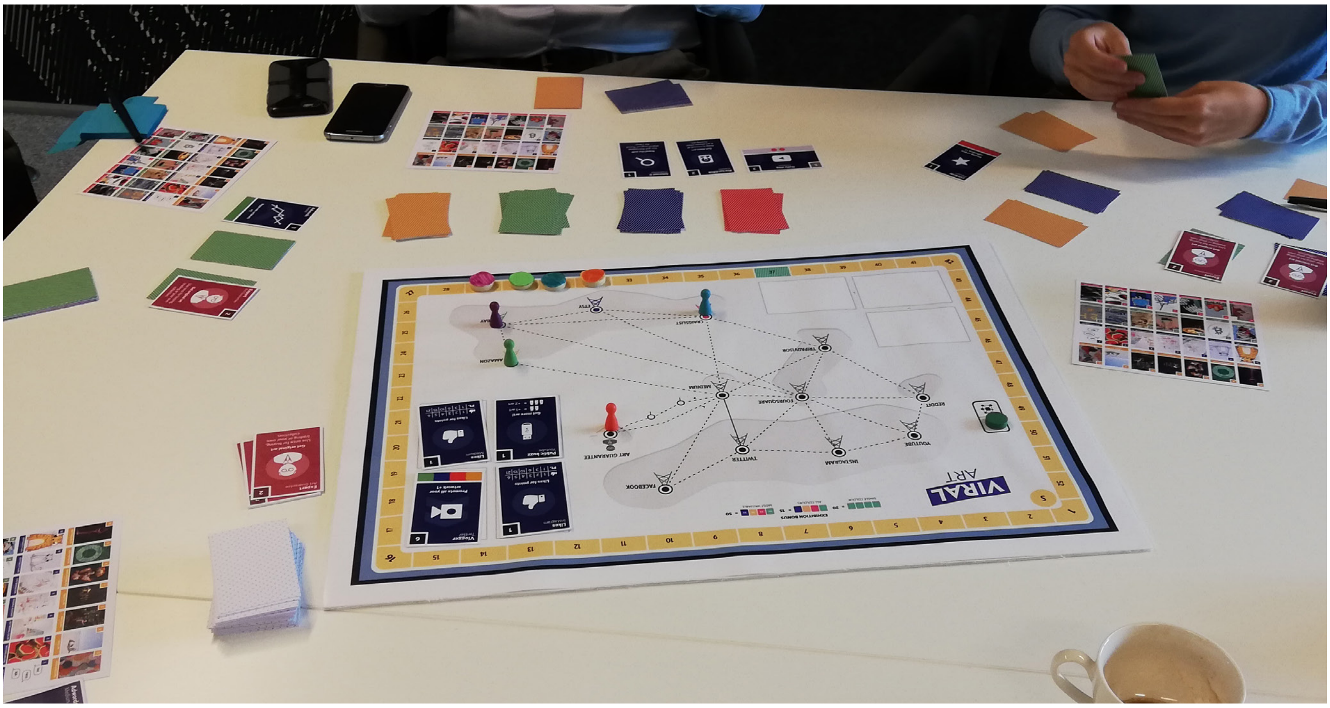


Figure 40: Image of final test of Viral Art game

VIRAL ART GAME

The final concept design is called 'Viral Art'. Viral Art is a game which allows clients to experience a new form of interaction with partners which blockchain technology brings. By taking participants through three distinct emotions in a game setting they can quickly get an idea of the emotional impact of the technology. The three emotions are: distrusting each other for direct interactions, being forced to trust an expensive middle man and finally trusting a collectively run system. The goal is to accelerate the understanding of blockchain and provide clients with a real sense of what it emotionally means to run a blockchain with other peers. As opposed to clients discovering this at the very end of a project. This can help clients with getting comfortable to working this way and provide some handles for ideation and implementation of further concepts. Having a personal experience of blockchain will also help clients in extending their story towards partners they would like to involve later on. Even better would be to perform this activity with partners of a potential ecosystem as to create a shared view on what the initiative will mean.

Storyline

In Viral Art (see figure 40), players place themselves in the shoes of a museum owner who is about to open a digital art gallery. A good opening needs a

Figure 41: Thebes board game by Queen Games. A game where players collect knowledge to dig for archeological treasures.

KEY MESSAGE

Besides being a game which is fun to play, it tries to bring across some key messages from both a trust stance as well as a blockchain perspective. These key messages are part of the discussion which is held after playing the game in a complete workshop setting.

Blockchain and trust:

- Blockchain will bring a shift in how clients exchange with partners and competitors. Also the target of trust will shift from an expensive middle man to a collectively supported system. -> Is the organization ready for this? How to deal with this and set it up with partners?

Blockchain constructs

- Blockchain technology makes transactions with partners more effective and efficient. This way a client can focus their resources on the right activities.
- Blockchains are maintained by decentrally updating the ledger for each transaction. Next to this, each change has to be approved by at least 51% of the group.
- Placing items on the blockchain allows digital assets to retain their value with certainty.

Justified trust

- A blockchain only works for data that 'someone' puts in the system. -> Who should this be?
- In a blockchain 'someone' has to see the contents of transactions to validate whether they are spend twice. -> Who should this be?
- Participants should be incentivized to provide the correct answers -> How will they be incentivized?
- Items only retain their value within the ecosystem. -> What happens to items outside of it?

BASIC CHARACTERISTICS

- 3 to 4 players
- 60 to 90 minutes gameplay
- competitive game
- most points for gallery wins

GAME COMPONENTS

Board (A)

The board represents 'the internet' where players can move their pawn across different platforms to execute actions. The top platforms were dedicated to buying virality cards, whereas the bottom four coloured platforms were meant for buying art.

Time

As part of the story players had only one year until the opening of their museum. Time was used as a key resource as it also plays a big role in real-life business challenges. Players could determine themselves how much time they wanted to spend in each turn on moving and executing actions.

Exhibition bonus (B)
To stimulate distrust and increase interaction amongst players (see appendix G), players can earn exhibition bonuses by completing certain combinations of art pieces. If players need specific art pieces they are more likely to engage in trading activities to get them. More interactions mean more chances for stimulating the right (dis)trust emotions.

Art cards (D)
These cards form the key components and collectibles of the game. Players can 'buy' art at the art platforms or trade them amongst each other. For each art piece there are three copies in the game. If players have all three, they have the 'original' and get full value. If two or more players own one or more copies, all art pieces are worthless. This was done to simulate the uncertainty of value of digital assets on the internet as no one knows if a copy was already sold to someone else.

Virality cards (E)
During the first experiment (see appendix G) it became clear that in a game setting blockchain technology takes away a lot of the risks in transacting with one another. This makes a game a lot less fun to play as everything becomes 'clear'. In order to keep the game interesting a second layer was added to the art trading layer: virality. Using different kinds of cards and actions players can increase the popularity of their art collection. Players can make use of 'adwords', get endorsement from 'vloggers' and contract 'celebrities' (see images on next pages). Adwords boost the value of one specific art piece. Vloggers are open to 'any endorsement they can find' and will boost all art pieces in the collection. Celebrities are more picky and only apply to one collection (colour) of art pieces.

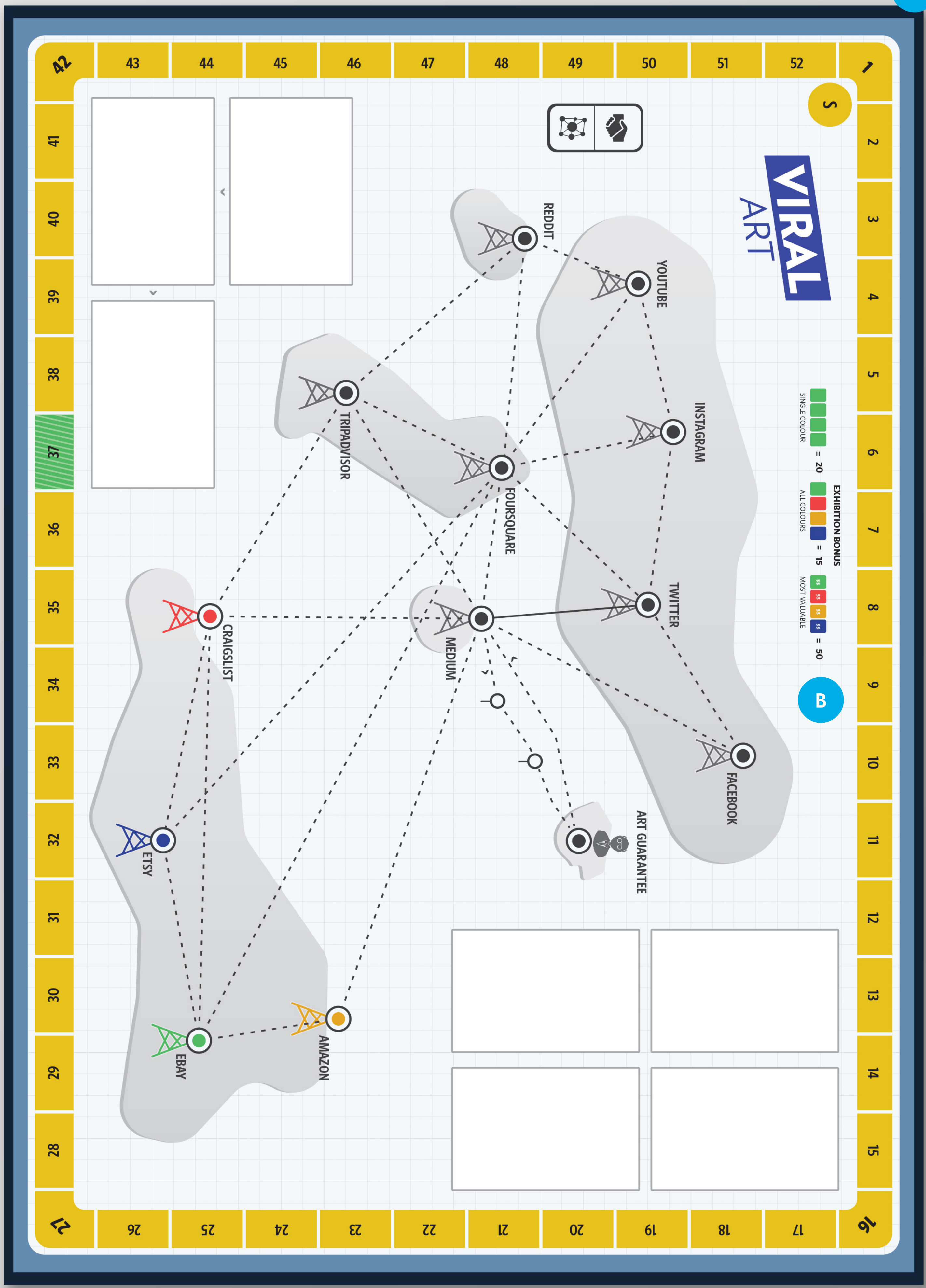
Expert card (F)
As seen in the case study, companies are used to dealing with partners or competitors through third parties. Although clients might be comfortable working in this way, there is a certain 'trust tax' which they pay (see chapter 3). To make players aware of these costs, an 'Expert' is introduced. This expert simulates the middle man, and is relatively expensive to buy (far away on the map and costly, see board on next page). However, if players do not trust other players in the direct transactions, they can choose to buy an expert in order to guarantee the uniqueness of one art piece. This card can be used for art acquired through buying and trading as well as already acquired art pieces. The intention is to make players feel 'forced' to deal with an expert, even though they don't necessarily want to as it is so expensive.

Promotion Tour and Daily Vlog (G)
Besides the virality cards, players can receive extra points by exhibiting a small collection of their art.

Trading
The goal of the trading component was to make participants feel the distrust in each other. As multiple copies were in the game a player could never be sure whether another player was offering him or her all the art pieces or one of the copies. This distrust should stimulate players to start to rely on the expensive middle man.

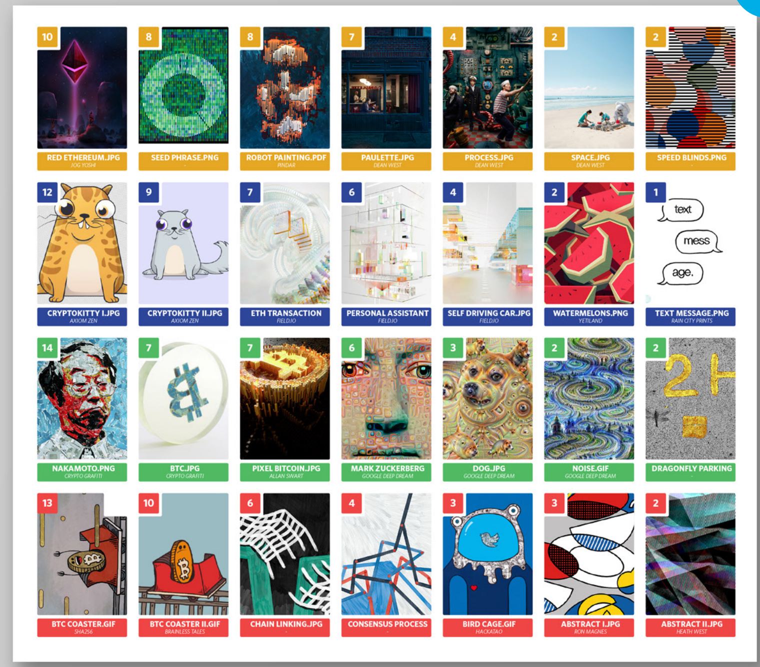
Blockchain simulation
As the goal was not to teach players all technical features of blockchain technology, a simplified simulation was set up. At the beginning of the phase players would place stickers with initials of the players that owned certain original art pieces on their overview board (see C on the next two pages). When new items were bought or traded, each player had to update their ledger with a new sticker. For each transaction players had to say 'approved' to seek accordance as a group.

A


VIRAL
ART
S
EXHIBITION BONUS
SINGLE COLOUR = 20
ALL COLOURS = 15
MOST VALUABLE = 50
B
REDDIT
YOUTUBE
INSTAGRAM
TRIPADVISOR
FOURSQUARE
TWITTER
CRAIGSLIST
MEDIUM
FACEBOOK
ART GUARANTEE
ETSY
EBAY
AMAZON
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52


VIRAL
ART
Rulebook

C


10
RED ETHEREUM.JPG
JOG YOSHI
8
SEED PHRASE.PNG
8
ROBOT PAINTING.PDF
PINDAR
7
PAULETTE.JPG
DEAN WEST
4
PROCESS.JPG
DEAN WEST
2
SPACE.JPG
DEAN WEST
2
SPEED BLINDS.PNG
12
CRYPTOKITTY I.JPG
AXIOM ZEN
9
CRYPTOKITTY II.JPG
AXIOM ZEN
7
ETH TRANSACTION
FIELD.IO
6
PERSONAL ASSISTANT
FIELD.IO
4
SELF DRIVING CAR.JPG
FIELD.IO
2
WATERMELONS.PNG
YETILAND
1
text
mess
age.
TEXT MESSAGE.PNG
RAIN CITY PRINTS
14
NAKAMOTO.PNG
CRYPTO GRAFITI
7
BTC.JPG
CRYPTO GRAFITI
7
PIXEL BITCOIN.JPG
ALLAN SWART
6
MARK ZUCKERBERG
GOOGLE DEEP DREAM
3
DOG.JPG
GOOGLE DEEP DREAM
2
NOISE.GIF
GOOGLE DEEP DREAM
2
DRAGONFLY PARKING
13
BTC COASTER.GIF
SHA256
10
BTC COASTER II.GIF
BRAINLESS TALES
6
CHAIN LINKING.JPG
4
CONSENSUS PROCESS
3
BIRD CAGE.GIF
HACKATAO
3
ABSTRACT I.JPG
RON MAGNES
2
ABSTRACT II.JPG
HEATH WEST

D

10

BTC COASTER II.GIF

BRAINLESS TALES

14

NAKAMOTO.PNG

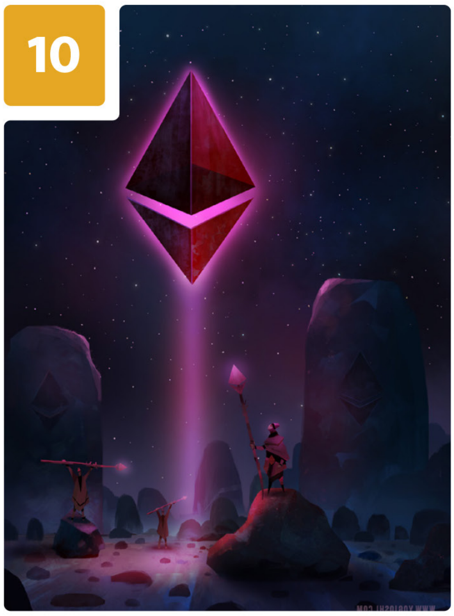
CRYPTO GRAFITI

12

CRYPTOKITTY I.JPG

AXIOM ZEN

10



RED ETHEREUM.JPG

JOG YOSHI

E

Internet I — 1
Youtube

Travel freely
Fast internet! Travel anywhere for free. Use only once.

Internet II — 1
Tripadvisor

Travel the web
You got the fastest search engine! Travel for 1 less.

Pro harddisk — 2
Instagram

Get more art
Keep 5 instead of 4 art pieces when buying art.

Likes — 1
Reddit

Likes for points

👍	1	2	3	4	5	6
Pt.	1	3	6	10	15	21

Public buzz — 1
Youtube

Get more art!
2 × USB = +1 art
3 × USB = +2 art

F

Expert — 2
Art Guarantee

Get original art
Use once for buying, trading or your own collection.

Vlogger — 6
Foursquare

Promote all your artwork +1

Celebrity — 2
Reddit

Virality of this collection +2

Adwords — 1
Youtube

Hype one artwork +2

G

7 — **Promotion Tour** — 4
Tripadvisor

5 — **Daily vlog** — 3
Twitter

GAMEPLAY

After setting up the board players take turns to execute both a movement and an action (promoting art, buying art, buying virality cards or getting an expert). For this they spend a certain amount of time as displayed on the cards and board. The player who's time marker is in the last position gets the next turn. In the first phase players start to collect art, trade art and can buy an expert to guarantee the uniqueness of an art piece. After each player has passed the 37th time marker, the narrator stops the game and a short discussion is held.

Players are asked how they feel, how they feel about the expert, how they feel about trading with other players and about using their resources.

Players are then notified that due to high demand an early exposition will take place of all museums. Each player opens his or her art pieces for each colour and compares them to the other players. All copies are worthless and will be put back into the art deck.

The narrator will mention that a new innovation has arrived on the internet, which is said to bring many efficiency boosts. Its called the blockchain. Players are asked whether they want to participate in this new technology or want to continue playing as they were. If so, the blockchain simulation begins.

The game ends when all players reach the start position again. All art pieces and virality bonuses are counted and the player with the highest total amount of points wins.

After the game a discussion is held on whether players noticed a difference between the phases. Then the narrator will highlight some of the key components which the game tried to expose. Here

chapter 9

Evaluation and recommen-dations

This chapter describes the evaluation of the game and theoretical discussion. Using this and the previous research, some recommendations will be given on game, workshop, project and company level.

The last version of the Viral Art game was evaluated with Cognizant consultants in a final play test at the Digital Studio of Cognizant. In two hours four employees from Cognizant completed the full game after which a discussion was held on different topics for evaluation. Participants included a business consultant, digital strategist, associate and a senior UX designer. All four were (very) familiar with blockchain technology and slightly with the topic of this project. The author of this report played the role of narrator and facilitator. Participants were given a very brief introduction of the research topic, but without mentioning the goal of the project as to not give away the 'emotions that had to be felt'. Players were told that the goal was to first play the game and afterwards discuss about it.

After this an introduction narrative was given on who the participants were playing in this game ("museum owners who want to open a digital art gallery" and some context ("beware, the internet is full of indistinguishable copies"). The goal and rules of the game were explained and the game started. During the game the narrator answered questions relating to rules or gameplay. Participants did make comments during the game with regards to gameplay and ideas, some were discussed but most were written down for later.

At time marker 37 the game was stopped for a minute. A small evaluation was held on how players were feeling, what they felt about the expert and about trading with other players. Then players were told that "because of high demand" an initial exposition would open. Every player had to open up their artwork and discover how many copies were in the game. Finally a new innovation was introduced: blockchain technology ("it is said to bring many efficiency boosts"). The group was given the choice whether they want to use this new technology for the rest of the game or not. A short explanation was given on how to simulate the blockchain (see chapter 8). The game was continued untill the end, where points were counted and a winner was announced. After the game a discussion was held on the key message of the game (whether it came across), the fit with Cognizant, the fit with clients and some notes on the gameplay.

INSIGHTS

Here are some of the key insights taken from the discussion. In a later paragraph recommendations will be given for further development of the game.

Game practicalities

Players seemed to be confronted with too many rules at the beginning of the game. "I lost you in the middle." After four rounds players knew how to play the game, but for a 'quick' starting activity this might be too long of an introduction. Besides the serious message which the game tries to bring across, the game seemed to be fun to play as well. People were laughing and trying to mislead each other through their actions. Numerous times participants tried to push the boundaries of the rules and explore alternate actions that weren't necessarily explained in the beginning. Clients might however be less inclined to do so. Next to this, the paper blockchain simulation was too much of a hassle which made it a bit of a barrier for playing the game. This should be made easier. Finally, four players seemed to be the limit of the game as to not make the turns too long.

Game provided the right experience

Asking the participants whether they would want to form a blockchain ecosystem made for an interesting dynamic. It was expected that everyone would say 'yes' immediately. However, this was not the case. Players were first evaluating for themselves how they had performed, comparing points with other players (as the cards were open by now) and discussing whether they wanted to go ahead. One player, the one with the most points, asked: *What if I say no?*. This option could potentially lead to a game where a part plays with the blockchain and a part plays without, to see the effect. Having players actively choose for new system stimulates the trust aspect. Players felt and noticed a behavior change in the new 'era'. Actions were more rewarding due to immediate results, tactics were less random and more focused on what was necessary. It's a good thing that players were discussing the choice as it clearly showcases the collective aspect of the technology. Participants expressed how blockchain really did make things easier. Also, one consultant mentioned:

I can ask someone have you experienced AR? They'll say yes. I can ask someone have you experienced AI? They'll say yes. But have they ever experienced blockchain? No of course not!

Fit with clients is not there yet.

During the discussion it seemed that the Cognizant employees were not fully confident in wanting to directly introduce this game to clients (*"For the right clients, with beers it would work very well."*). Initiating a board game to a client can be a bit odd and give unexpected reactions. When asked who they would introduce to this game employees mentioned clients that were 'already warmed up' or known for a longer time. In the discussion it became clear that two elements were challenging: a lack of digital technologies in the experience (*"More digital would be more logical for us.."*) and the lack of a clear key message for clients. The first one was due to the fact that in its current version the game was fully analogue. Cognizant is still a consultant around digital technologies, playing a fully analogue game therefore didn't feel like a complete match with the company's type of projects. Participants also expressed that introducing blockchain technology needs something more interesting and digital (e.g. connected iPads) rather than paper stickers. The second challenge was due to the lack of narration from the author and a missing complete story around the game. Clients might need to know why they are playing the game or what the key message is.

Although during this test no measurements were taken, Viral Art seems to succeed in simulating a behavior change and activating the thinking process around the new form of relationships that blockchain technology brings. It is clear that for such a game to have the right impact, a good narration and facilitator is needed. Such a game cannot 'just' be played on its' own but needs some context and guidance. The activity of choosing for the blockchain technology made it more of a trusting action, but further tests that include measurements of emotions during the game and an actual survey of built up trust would provide a quantified indication of the impact of the game. This would also provide more directions for improving the game.

Extra ideas that came from the test have been used for the recommendations (see later on) and a complete overview of observations/insights can be found in Appendix G ("Design Experiments" in sub-paragraph "Final Experiment").

THEORETIC DISCUSSION

This report has taken a broader look at blockchain technology through the lens of existing trust theory. Where much literature focuses on trust in technology for a specific exchange (e.g. sending one bitcoin, sharing medical data), this research identified different components which employees of a company are confronted with when dealing with blockchain technology. Additionally looking at activities that invoke uncertainty or involve a risk and thus require trust to be bridged. More specifically, this project looked at the initiation of the formation of a blockchain ecosystem amongst highly competitive retail players from the perspective of one initiating multinational shoe company. Two key conclusions can be drawn from this report.

Running it: Blockchain trust reach

In pure digital environments where transactions are about solely sending money or a file, the ecosystem consists of the user and the technology. In these cases, trust should not be placed in any single institution but rather in a collective group of supporters or in the algorithm itself. However, many ecosystems go beyond this and include physical products, human interactions, data providers, data points (e.g. RFID) and interfaces between all these. In this sense blockchain propositions don't exclude human interactions but at the same time cannot control these interactions (see chapter 4 & 5). Depending on the access point, the activity that a user wants to execute and the potential risk that is involved, the trustee and trusting bases might change. Justified trust then comes from placing trust in the trustee that can influence the outcome of the desired activity, in a reliable way and is willing to 'help' the trustor.

Running a blockchain is not only about technological trust but also about components of human trust.

The type of trust that plays a role in a blockchain system thus has a certain reach (see figure 43). Any external data, human interaction and environment sit beyond this reach.

Creating it: emotional challenge

Chapter 4 described how blockchain introduces a new form of trust: not trust in a mediating institutions nor in the exchange partner. Rather, people are asked to trust an algorithm which is maintained by a group of people who cannot influence the outcomes individually. However, before getting to this 'future state', employees (of a company) need to go through a 'transition phase' starting from the 'current state' (see figure 44).

Creating a blockchain is not just a technical feat but also a highly social and emotional endeavour.

Companies are used to working in a certain way which they might be comfortable with. Although often working with partners or competitors they shield themselves from undesirable scenario's through contracts, trusted third parties and lawyers. In the movement towards a blockchain ecosystem the case study found that initiating parties have to open up towards these partners more than they might be used to. This seemed scary because there is some vulnerability towards partners. Mentally clients are preparing for trust in a secure blockchain system, physically they still have to work closely with competitors and trust them to not misuse this collaboration.

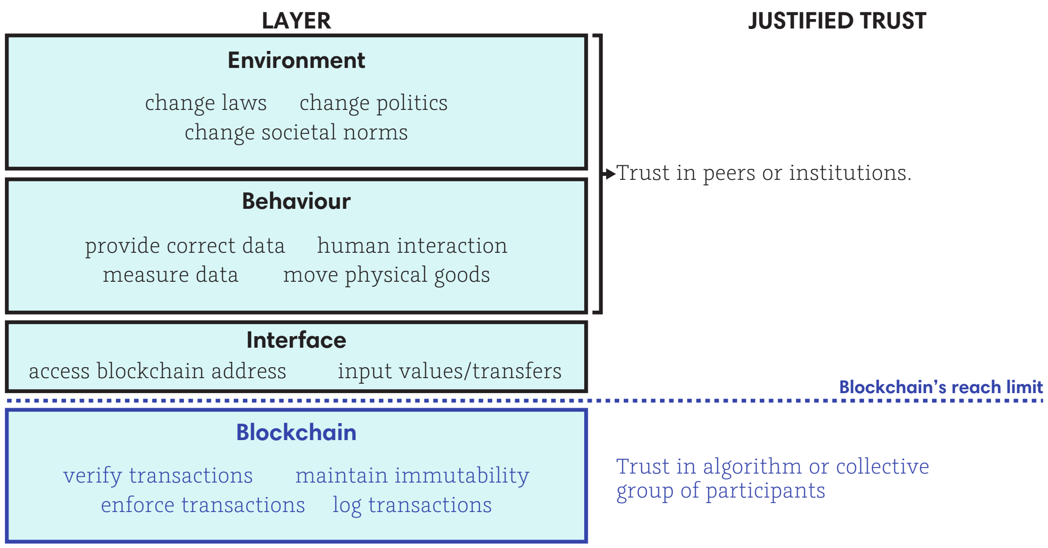


Figure 43: Reach of blockchain's trust.

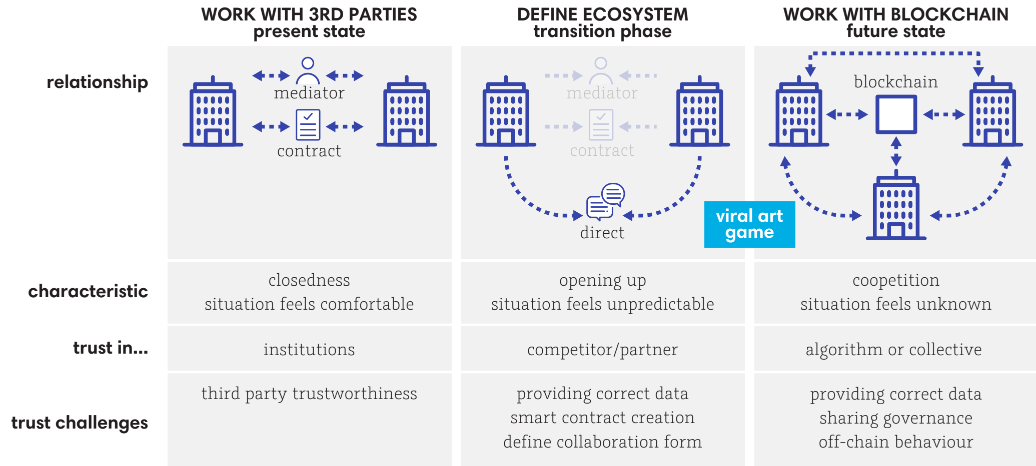


Figure 44: Blockchain's trust transitioning model

Viral Art game

The 'Viral Art' game that was introduced in this thesis tried to provide clients with a first look into the new mental trust model in the 'future state' (see above). The literature study described different intensities of trust (calculative, knowledge-based, identification-based, but transitioning between trust models could be an interesting topic for further research. There might be some tension at the moment when trust is transfered from the people (whilst setting it up) to the system (when running). Whether this is gradual or instantanious is still open. This might also differ very much between a client/organization who is moving towards a new blockchain ecosystem and an individual user who is trying a new system. Providers of blockchain systems might need to give support for this mental transition. Although no measurements were taken on impact, the game ha shown how blockchain technology can be simplified in an experience that balances 'how it works' and 'what it provides'. Also providing an experience that showcases two forms of trust: trust in direct partners/institutions towards trust in a collectively run system.

Limitations

The game tried to form stronger trust through trust interactions. However, the technology was simulated. Trust necessity and formulation might be stronger if participants were relying on a real form of the technology. Next to this, a simulation might nudge participants' trust towards the facilitator of the game, rather than the technology (simulation) itself.

Also, as mentioned in the literature study, trust is domain specific. It will differ per person and organization what activity it is that they trust blockchain the least for in terms of fulfilling. The game simulated an activity of 'trading art' in which cases blockchain helps to 'establishes and maintains value of an item. Not all usecases that clients work on will necessarily include this activity. In such a case the game is more of an active learning experience on changing relationship rather than actually building trust in blockchain technology.

The case study executed in this report did not include formal interviews or surveys. Conclusions were drawn from observations and informal discussions. Performing surveys on trust levels during such a project could provide stronger indications and points to focus on. Interviews could give depth to the topics mentioned in this report. Next to this the importance of trust might differ for a high level manager and an operational employee. Higher level managers might feel more like they have something to 'lose' when adopting a technology like blockchain and thus need to trust it more, whereas other employees might experience less potential risk and thus be more eager to engage.

RECOMMENDATIONS

1. On game design

Based on the final evaluation session some recommendations for further game development can be described.

Create a stronger role for the facilitator: perform actions to steer the group (e.g.: comment on participants' current situation, mention options to stimulate actions). Also having a stronger exciting introduction that fits with a client's context would add to the experience. The facilitator should act both as moderator, narrator as well as the 'art guarantee expert'.

Increase the black and white effect: The game's impact relies heavily on showing the difference between before and after. To increase this black and white effect of with and without blockchain the facilitator could be heavily involved in the first phase but almost completely step out in the second phase and let the players simulate the blockchain on their own. This also allows for a better group and individual experience.

Make the simulation of the blockchain more immersive: To increase both the fit of the game with Cognizant as well as the impact of the technology, the second phase of the game could use a digital element instead of paper and dotted stickers. However, it is still important that the technology is not masked and participants still see what the technology is doing for them. Players could get a tablet which registers the transactions linking it to the pawns' position on the time marker on the board. Another addition could be to verify a transaction individually and afterwards passing the tablet around to simulate the collective verification process.

2. On workshop design

During the final test it became clear that the game on its' own is not yet capable of reaching the desired impact. To make the game more useful it should be part of a broader workshop setting. This workshop should have one clear overall key message and objective for participants to make clear what they will get out of it. Next to the game other activities should be added such as a strong introduction around the value of the technology, a good discussion after the game on what was experienced and a brainstorm session on how this would translate to the clients (and partners) situation.

3. On project activities

Full trust, and eventually adoption, isn't built through only a game. Besides the activities that Cognizant already does some extra attention points were defined:

From passive to active: Moving forward from the game the goal would be to provide as many experiences as possible, rather than only bringing across knowledge. Small things like letting the employees of a client execute the blockchain end-demo rather than Cognizant consultants showing it can also add to this. Experiences can be done in all sorts of formats, as long as the client gets the freedom to 'explore' a certain aspect/technology/concept themselves. Even a session where insights of the project so far have to be shared could be an experience where participants explore the insights in an interactive way (e.g. walking around a room with insights across the walls). It doesn't have to be digital to work. The book 'Communicating the New' has some good insights on this.

Build trust through reputation: Cognizant already showed some blockchain case examples. For building initial trust this can be very strong. Showing references to other projects and real opinions of real people attached to this projects would be even stronger. Show what kind of people have been helped and in what kind of way. Inviting previous clients to tell about their experience with the technology would be better.

Grab blockchain's narrative and clarify boundaries: Trust is all about what a technology might or might not deliver upon. In the case of blockchain technology it seemed hard to grasp for clients what it can and can't do, let alone design with it. It would be very relevant for blockchain projects to have a clear 'scoping' session on what it is and what it isn't. Getting a shared understanding of its' value and capabilities can help throughout the whole project. This session could start by asking people to write down how they perceive the technology (e.g. to spot potential sceptics, identify faulty background narratives) and what they think it can do. Even hanging a poster on the project wall with its' limitations (e.g. "10 Myths about Blockchain Tech") would add to this. From a consulting perspective it is also good to be honest about the technology's limits (e.g. blockchain cannot check incoming data for correctness, see chapter 4). Explain the elements that support trustworthiness and provide clients with a good feeling of what it really means to work with such a system (e.g. what parties are involved, level of transparency) at the beginning of a project.

Understand the emotional challenge: Cognizant consultants should understand that the 'coopetition' paradox is challenging for clients to take on. Although running a blockchain is secure and 'private' from a theoretical perspective, the steps towards running an ecosystem can feel like opening up for a client (see chapter 5). Instead of having clients discover this at the end, it is good to guide clients with this. Explain at the beginning that they might feel this during the project and that blockchain impacts the way they work with partners. One way to approach this is by setting up a parallel 'ecosystem track' (next to business value, technology, finance) really focused on how to involve partners and setting up a strategy to do so.

4. On Cognizant practice

In the broadest sense, Cognizant could add a service to its' service portfolio to complement current consultancy practices. Here are some ideas based on the findings in this report:

Become an ecocystem builder: A blockchain system only provides value when all parties trust the system that is implemented. The goal of a blockchain project should not be to develop a concept in-house but to actually establish an ecosystem. Cognizant has the right knowledge to fulfill this role. Acting as a neutral party in the group, Cognizant could link technical, business and user demands from all involved parties and find a middle ground for the system. ognizant could warm up partners for blockchain proposition through experiences. Clients might not have the 'right' knowledge and language to educate their partners on blockchain, this is where Cognizant could come in.
Besides these operational elements, this service should focus on a more strategic level: how does the client want to work with partners, how much should be shared, how does this impact the business beyond the proposition.

Supplement with data integrity: Once a blockchain system is running, the critical aspect moves from consensus/verification/writing the ledger towards obtaining correct input data. The weakest point of a blockchain is the incoming data (garbage in, garbate out concept). Cognizant could offer additional services around blockchain concepts that look at the data integrity of clients and their partners. Within this data integrity can be a whole range of services (data sourcing analysis, setting up data collection, maintaining accurate data).

Build blockchain minimum viable products: In the case study it became clear that clients have to wait quite a while before they get to experience a blockchain concept. Experiencing this helps with the understanding and adoption. Cognizant could try to learn how to build mininum viable products for blockchain that can be build within one week, to pull these demo's to the front of a project. These should be formats that require less coding but do showcase the impact of the proposition.

chapter 10
Conclusion and personal reflection

This project was executed in the context of Cognizant digital consultancy and focused on the main research question: 'How to design for trust in blockchain solutions'.

Based on a literature research, technology analysis and a case study, insights were derived which give an idea of how trust plays a role in blockchain ecosystem and the practicalities surrounding it.

Even though blockchain systems provide many elements of transparency and security, they are not completely trustless. A lack of computer literacy, fuzzy governance, human behaviour/ physical products, external data, cryptocurrency valuation and increased necessity of self-confidence all bring a form of uncertainty to a blockchain ecosystem which need a form of trust to be bridged. Also, anyone engaging with a blockchain ecosystem might appoint a central entity as the trustee, but this would not result in justified trust as those entities cannot insure any desired outcome individually. Rather, people will need to place their trust in a collection of components that is controlled by an algorithm and collective verifying group.

Results from the case study showed that adopting blockchain technology is not just a technical or business feat but also an emotional and social endeavor. Setting up an ecosystem can feel like opening up, result in uncomfortable interactions with competitors and requires clients to mentally shift to a new form of trust relationship which they might not be familiar with.

Cognizant could play a key role in making clients comfortable with this new form of interaction by offering direct experiences with blockchain rather than only knowledge transfer. Eventually the company could position itself as an 'ecosystem builder', providing support to not only the client but also the partners in shaping the ecosystem and relationships.

These insights laid the foundation for the design of an interactive game called 'Viral Art' which allows clients of Cognizant to become acquainted with the new form of trust that the technology brings. The game simulates a blockchain in a simple way and guides participants through a phase of direct trust/institutional trust to a phase where trust is placed in the collective. This experience should help clients to mentally prepare for running a blockchain network and lead to a discussion on the impact that the technology will have on the relationship with clients and how to best approach this.

Looking at the research question, it can be said that designing for trust in blockchain technology is still a very open and broad topic. It depends heavily on the activity that a client or user is trying to achieve, what aspects matter most in terms of trust. Much more research can be done into how trust plays a role in specific scenarios. In any case, time will tell what it takes for consumers and organizations to fully trust blockchain systems.

PERSONAL REFLECTION

I have truly enjoyed working alongside Cognizant's consultants and experiencing first-hand how they execute cool blockchain projects. Coming in as an external graduate student gave me the luxury position of picking out all the fun activities to join.

In the first part of the project one of my biggest struggles was the fact that the case study started immediately alongside the literature study. It took me a while to get a grasp on the topics of 'trust' and 'blockchain technology' meaning that I didn't really know beforehand what exactly to look at. This meant I was trying to observe everything at the same time without a clear focus or research question. Although I could derive interesting insights from the case study, they would have been more 'sharp' if I had specific aspects to look at. Also the initial idea of designing something for the case study felt too much like mingling with the work that Cognizant was already doing. This made me eventually shift the focus of the project towards an activity for Cognizant rather than a service design for a client.

Another thing I noticed is that I wasn't always focused on impact (e.g. I eventually didn't do a measurement of impact of the game in the experiment). As the topic was quite broad I sometimes lost track of what my actual goal was, sometimes the project felt more like an exploration of a new domain rather than a mission to achieve something specific. This showed me the importance of scoping a project and really defining what the project should bring in the end. I was lucky enough to have mentors that gave me space to 'float' in this domain, but I'm aware that in a business context there isn't always room for this.

A major difference between team projects and executing a project on your own for me was that I was used to sharing the uncertainty or vagueness of a project with other people, making decisions as a group and dealing with the consequences as a group as well. Whereas now it felt like I was carrying the whole uncertainty of the project myself. This was probably the hardest part of the project but I quickly found out that talking to as many people as possible about what I'm doing helps me progress.

I learned a lot of about the added value of strategic designers, being able to go through the whole fuzzy phase of defining a challenge worth solving to actually creating something tangible to make your point. I also learned what its' not easy to be a good designer, having to juggle all different perspectives on the challenge. At times I focused too much on theory, and forgot some basics like identifying persona's for the clients and designing more from their perspective. Also, making concept more concrete, translating them into visuals or drawings helps in creating engagement with people.

Looking at my personal ambitions, I think I succeeded in following my own opinion and trying to lead the coaching sessions. However, I still struggle with saying this is a good or bad direction and prefer to have some form of confirmation. Next to this, I learned a lot about blockchain in practice and especially enjoyed seeing the reactions of clients to such a new disruptive technology. Finally, I tried to take findings from literature to practice but did notice that at one point you need to really 'start designing' and let go a bit of the literature. It helps however to have a good base and use the literature to evaluate your concept in the end.

Bibliography

Andreessen, M. "Why Bitcoin Matters." *The New York Times*. 2014.

Baier, A. "Trust and antitrust." *Ethics* 96, no. 2 (1986): 231-260.

Bigley, G. A., J. L. Pearce. "Straining for shared meaning in organization science: Problems of trust and distrust. *Academy of management review* 23, no. 3 (1998): 405-421.

Blechschmidt, B., C. Stöcker. "How Blockchain Can Slash the Manufacturing "Trust Tax". *Cognizant*. 2016. https://www.cognizant.com/whitepapers/how-blockchain-can-slash-the-manufac turing-trust-tax-codex2279.pdf

Botsman, R. "How the blockchain is redefining trust." *Wired*. December 27, 2017, https://www. wired.com/story/how-the-blockchain-is-redefining-trust/.

Botsman, R. "Thinking.". Rachel Botsman. https://rachelbotsman.com/thinking/

Botsman, R. "We've stopped trusting institutions and started trusting strangers.". *TED*. YouTube video. November 7, 2016. https://www.youtube.com/watch?v=GqGksNRYu8s.

Botsman, R. "The three steps of building trust in new ideas and businesses." *TED*. December 8, 2017. https://ideas.ted.com/the-three-steps-of-building-trust-in-new-ideas-and-busines ses/

Bracamonte, V., H. Okada. "The issue of user trust in decentralized applications running on block chain platforms." Paper presented at the *IEEE International Symposium on Technology and Society*, Sydney, Australia, August, 2017: 1-4.

Brooks, P. A. "VW Notice of Violation, Clean Air Act." *EPA*. September 18, 2015. https://www.epa. gov/sites/production/files/2015-10/documents/vw-nov-caa-09-18-15.pdf

Butterin, V. "On Public and Private Blockchains." *Ethereum.org*. August 7, 2015. https://blog.ether eum.org/2015/08/07/on-public-and-private-blockchains/

Cadwalladr, C., E. Graham-Harrison. "Revealed: 50 million Facebook profiles harvested for Cambridge Analytica in major data breach." *The Guardian*. March 17, 2018. https://www. theguardian.com/news/2018/mar/17/cambridge-analytica-facebook-influence-us-elect ion.

Carmody, B. "Beyond Crypto-Mania: Understanding The True Value of Blockchain." *INC*. Janu ary 21, 2018. https://www.inc.com/bill-carmody/beyond-crypto-mania-understa nding-true-value-of-blockchain.html

Carson, B., G. Romanelli, A. Zhumaev and P. Walsh. "Blockchain beyond the hype: What is the strategic business value?" *McKinsey*. June, 2018. https://www.mckinsey.com/busi ness-functions/digital-mckinsey/our-insights/blockchain-beyond-the-hype-what-is-the-strategic-business-value

Casey, M. “The Blockchain: Decentralized trust to unlock a decentralized future”. *Oreilly*. September 8, 2016. https://www.oreilly.com/ideas/the-blockchain-decentralized-trust-to-un lock-a-decentralized-future

Casey, M.J. and P. Vigna. *The Truth Machine: The Blockchain and the Future of Everything*. Harper Collins, 2018.

Chakravorti. “Trust in Digital Technology Will Be the Internet’s Next Frontier for 208 and Beyond.” *Scientificamerican*. January 4, 2018. https://www.scientificamerican.com/article/trust-in-digital-technology-will-be-the-internet-rsquo-s-next-frontier-for-2018-and-beyond/

Chintamaneni, P. and L. Varghese. “Blockchain: Instead of Why, Ask Why Not?” *Cognizant*. 2016. https://www.cognizant.com/whitepapers/Blockchain-Instead-of-Why-Ask-Why-Not-co dex1973.pdf

Christidis, K. and M. Devetsikiotis. “Blockchains and smart contracts for the internet of things.” *IEEE Access*, 4 (2016): 2292-2303.

Christopher, C. M. “The Bridging Model: Exploring the Roles of Trust and Enforcement in Banking, Bitcoin, and the Blockchain.” *Nev. LJ* 17: 139.

Clegg, C., K. Unsworth, O. Epitropaki and G. Parker. “Implicating trust in the innovation process.” *Journal of Occupational and Organizational Psychology* 75, no. 4 (2002): 409-422.

Cofta, P. “Trust, complexity and control: confidence in a convergent world.” *John Wiley & Sons*. 2007.

Cognizant. “2016 Annual Report – Helping Clients Build and Run Digital Business.” *Cognizant*. 2017. https://www.cognizant.com/content/dam/cognizant_foundation/investors/2016/ annual-report.pdf

Cognizant. “Driving Digital Change.” *Cognizant*. https://www.cognizant.com/nl-nl/drivingdigital change

CoinMarketCap. “All Cryptocurrencies.” *CoinMarketCap*. https://coinmarketcap.com/all/views/all/

Corda. “Notaries”. *Corda*. https://docs.corda.net/key-concepts-notaries.html

Corda. “States”. *Corda*. https://docs.corda.net/key-concepts-states.html#the-vault

Cross, F. B. “Law and trust.” *Geo LJ* 93 (2004): 1457

Deloitte. “Blockchain – Legal implications, questions, opportunities and risks.” *Deloitte*. March, 2018. https://www2.deloitte.com/content/dam/Deloitte/be/Documents/legal/Blockchain%20 Booklet%20March2018.pdf

Diekhöner, P. K. *The Trust Economy: Building strong networks and realizing exponential value in the digital age*. Marshall Cavendish International Asia Pte Ltd, 2017.

Diener, E. and M.E. Seligman. “Beyond money: Toward an economy of well-being.” *Psychological sci ence in the public interest* 5, no. 1 (2004): 1-31.

Edelman. “2018 Edelman Trust Barometer.” *Edelman*. 2018. https://www.edelman.com/trust-ba rometer

Edelman. “Trust in technology.” *Edelman*. 2018. https://www.edelman.com/post/trust-in-technolo gy-2018

Elsden, C., A. Manohar, J. Briggs, M. Harding, C. Speed and J. Vines. "Making Sense of Blockchain Applications: A Typology for HCI." Paper presented at the *2018 CHI Conference on Human Factors in Computing Systems*, Montreal, Canada, April 21 – 26, 2018: 458.

Ford, P. "Our Fear of Artificial Intelligence." *MIT Technology Review*. February 11, 2015. https://www.technologyreview.com/s/534871/our-fear-of-artificial-intelligence/

Griffith, E. "The Hustlers Fueling Cryptocurrency's Marketing Machine." *Wired*. June 12, 2018. https://www.wired.com/story/the-hustlers-fueling-cryptocurrencys-marketing-machine/

Harford, T. "The Economics of Trust." *Forbes*. November 3, 2006. https://www.forbes.com/2006/09/22/trust-economy-markets-tech_cx_th_06trust_0925harford.html#5582cf62e138

Hawlitschek, F., B. Notheisen and T. Teubner. "The limits of trust-free systems: A literature review on blockchain technology and trust in the sharing economy." *Electronic Commerce Research and Applications* 29 (2018): 50-63.

Hurst, M. "The Google Glass feature no one is talking about." *Creative Good*. February 28, 2013. http://creativegood.com/blog/the-google-glass-feature-no-one-is-talking-about/

Ianisiti, M. and K.R. Lakhani. "The Truth About Blockchain." *HBR*. January, 2017. https://hbr.org/2017/01/the-truth-about-blockchain

IDC. "New IDC Spending Guide Sees Worldwide Blockchain Spending Growing to 9.7 Billion in 2021." *IDC*. January 24, 2018. https://www.idc.com/getdoc.jsp?containerId=prUS43526618

Kobie, N. "How much energy does bitcoin mining really use. It's complicated." *WIRED*. December 2, 2017. https://www.wired.co.uk/article/how-much-energy-does-bitcoin-mining-really-use

Kostarev, G. "Review of blockchain consensus mechanisms." *Medium*. July 31, 2017. https://blog.wavesplatform.com/review-of-blockchain-consensus-mechanisms-f575afae38f2

Lankton, N.K., D.H. McKnight and J. Tripp. "Technology, humanness, and trust: Rethinking trust in technology." *Journal of the Association for Information Systems* 16, no. 10 (2015): 880.

Lewicki, R.J., B.B. Bunker. "Developing and maintaining trust in work relationships." *Trust in organizations: Frontiers of theory and research* 114 (1996): 139.

Lumineau, F. "How contracts influence trust and distrust." *Journal of Management* 43, no. 5 (2017): 1553-1577.

Li, X., T.J. Hess and J.S. Valacich. "Why do we trust new technology? A study of initial trust formation with organizational information systems." *The Journal of Strategic Information Systems* 17, no. 1 (2008): 39-71.

Luo, X. "Trust production and privacy concerns on the Internet: A framework based on relationship marketing and social exchange theory." *Industrial Marketing Management* 31, no. 2 (2002): 111-118

Marlin, D. "What Is Blockchain And How Will It Change The World?" *Forbes*. December 22, 2017. https://www.forbes.com/sites/danielmarlin/2017/12/22/what-is-blockchain-and-how-will-it-change-the-world/#30dae25b7560

Mayer, R.C., J.H. Davis and F.D. Schoorman. "An integrative model of organizational trust." *Acade my of management review* 20, no. 3 (1995): 709-734.

McDonald, A.M. and L.F. Cranor. "The cost of reading privacy policies." *ISJLP* 4 (2008): 543

McKnight, D.H. and N.L. Chervany. "What trust means in e-commerce customer relationships: An interdisciplinary conceptual typology." *International journal of electronic commerce* 6, no. 2 (2001): 35-59.

McKnight, D.H., M. Carter, J.B. Thatcher and P.F. Clay. "Trust in a specific technology: An inves tigation of its components and measures." *ACM Transactions on Management Information Systems (TMIS)* 2, no. 2 (2011): 12.

McKnight, D.H., V. Choudhury and C. Kacmar. "The impact of initial consumer trust on intentions to transact with a web site: a trust building model. *The journal of strategic information sys tems* 11 no. 3-4 (2002): 297-323.

Mearian, L. "What is Blockchain? The most disruptive tech in decades." *Computerworld*. January 18, 2018. https://www.computerworld.com/article/3191077/security/what-is-blockchain-the-most-disruptive-tech-in-decades.html

Miltgen, C.L., A. Popovič and T. Oliveira. "Determinants of end-user acceptance of biometrics: In tegrating the 'Big 3' of technology acceptance with privacy context." *Decision Support Sys tems* 56 (2013): 103-114.

Moy, J. "Forget Bitcoin, It's All About The Blockchain". *Forbes*. February 22, 2018. https://www.for bes.com/sites/jamiemoy/2018/02/22/forget-bitcoin-its-all-about-the-block chain/2/#50a64e434719

Nakamoto, S. "Bitcoin: A peer-to-peer electronic cash system." (2008).

Nauert PhD, R. "Why Do We Anthropomorphize?" *Psych Central*. 2015. Accessed May 30, 2018. https://psychcentral.com/news/2010/03/01/why-do-we-anthropomorphize/11766.html

Nickel, P.J. "Design for the Value of Trust." *Handbook of Ethics, Values and Technological Design: Sources, Theory, Values and Application Domains* (2015): 551-567.

Nowak, K. L. and C. Rauh. "The influence of the avatar on online perceptions of anthropomor phism, androgyny, credibility, homophily, and attraction." *Journal of Computer-Mediated Communication* 11, no. 1 (2005): 153-178.

O'Connor, C. "What blockchain means for you, and the Internet of Things." *IBM*. February 10, 2017. https://www.ibm.com/blogs/internet-of-things/watson-iot-blockchain/

O'Kane, A.A., C. Detweiler and A. Pommeranz. "Designing and evaluating for trust: a perspective from the new practitioners." *1st International Workshop on Values in Design-Building Bridges between RE, HCI and Ethics*. September, 2011: 48.

Ou, C.X. and C.L. Sia. "To trust or to distrust, that is the question: investigating the trust-distrust paradox." *Communications of the ACM* 52, No. 5 (2009):135-139.

Panetta, K. "Top Trends in the Gartner Hype Cycle for Emerging Technologies." *Gartner*. August 15,

2017. https://www.gartner.com/smarterwithgartner/top-trends-in-the-gartner-hype-cycle-for-emerging-technologies-2017/

Pavlidis, M. "Designing for Trust" *CAiSE (Doctoral Consortium)* (2011): 3-14.

Pavlou, P.A. "Consumer acceptance of electronic commerce: Integrating trust and risk with the technology acceptance model." *International journal of electronic commerce* 7, no. 3 (2003): 101-134.

Raul. "The Speed of Crypto Hacks is Picking Up: This Month Alone Thieves Stole $71.5M. *howmuch.net*. June 19, 2018. https://howmuch.net/articles/biggest-crypto-hacks-scams

Rezendes, M. "Church allowed abuse by priest for years." *The Boston Globe*. January 6, 2002. https://www.bostonglobe.com/news/special-reports/2002/01/06/church-allowed-abuse-priest-for-years/cSHfGkTIrAT25qKGvBuDNM/story.html

Riegelsberger, J., M.A. Sasse and J.D. McCarthy. "The mechanics of trust: A framework for research and design." *International Journal of Human-Computer Studies* 62, no. 3 (2005): 381-422.

Riker, W.H. "The nature of trust" *Social Power and Political Influence* (2017): 63-81.

Rogers, E.M. and F.F. Schoemaker. *Communication of Innovations; A Cross-Cultural Approach*. New York, USA: Free Press, 1971.

Sas, C. and I.E. Khairuddin. "Design for Trust: An exploration of the challenges and opportunities of bitcoin users." Paper presented at the *2017 CHI Conference on Human Factors in Computing Systems*, May, 2017: 6499-6510

Scheer, L.K. "Trust, Distrust and Confidence in B2B Relationships." In *Handbook on Business to Business Marketing*, 332. Edward Elgar, 2012.

Schoedon. "The Ethereum-Blockchain size will not exceed 1TB anytime soon." *Medium*. 2017. https://dev.to/5chdn/the-ethereum-blockchain-size-will-not-exceed-1tb-anytime-soon-58a

Sitkin, S.B. and L.R. Weingart. "Determinants of risky decision-making behavior: A test of the mediating role of risk perceptions and propensity." *Academy of management Journal* 38, no. 6 (1995): 1573-1592.

Solhaug, B. and K. Stølen. "Uncertainty, subjectivity, trust and risk: How it all fits together." *International Workshop on Security and Trust Management*, Berlin, Heidelberg, June 2011: 1-5.

Swan, M. *Blockchain: Blueprint for a new economy*. O'Reilly Media, 2015.

Tan, Y and W. Thoen. "Toward a generic model of trust for electronic commerce." *International journal of electronic commerce* 5, no. 2 (2000): 61-74.

Tapscott, D. and A. Tapscott. *Bockchain revolution: how the technology behind bitcoin is changing money, business, and the world*. Penguin, 2016.

Travelex. "Current world currencies." *Travelex*. https://www.travelex.com/currency/current-world-currencies

Unibright.IO. "Blockchain evolution: from 1.0 to 4.0." *Medium*. December 7, 2017. https://medium.com/@UnibrightIO/blockchain-evolution-from-1-0-to-4-0-3fbdbccfc666

Walport, M. "Distributed Ledger Technology: beyonc blockchain." *Government Office for Science*.

2016. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/492972/gs-16-1-distributed-ledger-technology.pdf

Wanitcharakkhakul, L. and S. Rotchanakitumnuai. "Blockchain Technology Acceptance in Electronic Medical Record System." Paper presented at the *17th International Conference on Electronic Business*, Dubai, UAE, December 4 – December 8, 2017: 53-58.

Werbach, K. "Trustless trust." Paper presented at the *44th Research Conference on Communication, Information and Internet Policy*, Arlington, VA, September 30 – October 1, 2016.

Wüst, K. and A. Gervais. "Do you need a Blockchain?." *IACR Cryptology ePrint Archive* (2017): 375

Yli-Huumo, J., D. Ko, S. Choi, S. Park and K. Smolander. "Where is current research on blockchain technology? – a systematic review." *PloS one* 11, no. 10 (2016)