

How Blockchain technology and other innovations change(d) the future of banking

A Master's Thesis submitted for the degree of
"Master of Business Administration"

supervised by
Marc Gruber

Maria Semenchenko

h0350489

Vienna, 2016

Affidavit

I, **Maria Semenchko**, hereby declare

1. that I am the sole author of the present Master's Thesis, "How blockchain and other innovations change(d) the future of banking", 92 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted this Master's Thesis as an examination paper in any form in Austria or abroad.

Vienna, 30.06.2016

Signature

Abstract

How Blockchain technology and other innovations change(d) the future of banking

The financial sector has become a fast-moving arena for new players, venture capitalists and technological innovators, where traditional banks are not fitting. It is essential for banks not only to embrace innovation, but also reconsider the whole value chain and relationships with a customer. New technologies like Blockchain could significantly reduce internal and external costs, associated with banking services and contribute to a faster digital transformation of incumbents.

Blockchain is one of the key break-through technologies massively debated in the media and among financial expert is Blockchain technology. This technology is a decentralized ledger, working like a public ledger with distributed participants, where transactions are verified by the network, without any central authority.

The beauty of the system is in its auditable, cost-effective and cryptographically protected secure nature. It is a new way to create and transform the value in the real-time. This disruptive technology is promising a real revolution in financial sector, which big banks don't want to miss. There are already many use cases, where this technology can significantly improve banking operations and processes, among them are international payments, smart contracts, digital identity and smart assets. And many more to discover.

The Blockchain technology is however in its early stage of experimentation, where there is a lot of uncertainty about.

As there is a big interest from banks, regulators to investigate this technology in terms of justification of a business case and its usability, the adoption curve will be shortening year by year, as this collaborative actions will be bringing fruits very soon.

Banks at the same time, should carefully investigate all innovations existing on the market, before integrating them into their existing organizations.

It is important to look at these innovations from the business case perspective, not just following the trend with the peers. The future of banks is not in fragmental update in their services or systems, but in redesigning their business models, reinvention of their new digital identities, and disruptive innovations can be just supportive steps on their transformations.

Table of contents

Abstract	iv
Table of contents	v
Table of figures	vi
Table of tables	vii
1 Introduction	1
2 Literature review	5
2.1 Why innovations are vital for organizations?	5
2.2 Disruptive innovations	8
2.2.1 Service innovations	9
2.3 Innovations in banking in the past and now	12
2.3.1 Innovations in banking in the past.	12
2.3.2 Innovations in financial sector now.....	14
2.4 Asymmetry in adoption of innovations in developed vs. developing countries	18
2.4.1 How many debit /credit cards are available in China?	19
2.5 FinTech: a new kid on the block	21
2.5.2 Bitcoin and Blockchain in the financial sector, is it a trend or here to stay?.....	26
2.5.3 Why banks are looking at Blockchain technology?	31
2.6 Innovation strategy of banks	32
2.6.1 Digital, Open Bank	32
2.6.2 Shifts in customer behaviour.....	35
2.6.3 Innovation as a marketing strategy	37
2.6.4 Business model.....	38
3 Methods	40
3.1 General information on international payments (cross-border payments)	41
3.1.1 AS IS analysis on the current situation with international transactions.	41
3.1.2 TO BE solution for international transactions with Ripple’s technology	43
3.1.3 Profits of banks on international transactions	45
3.2 Innovative solution for international payments in Fintech	46
3.3 Business case calculation	47
3.4 Sensing the trend	51
4 Results and analysis	53
4.1 Regulatory framework, policy challenges (EU, USA, UK)	53
4.1.1 Europe	54
4.1.2 National levels	57
4.2 The roadmap of the Blockchain technology	62
4.3 Money Laundry and financial crime	65
4.4 Security issues related to the technology	66
4.5 Smart contracts	68
5 Conclusion	69
Bibliography	71
Pavitt Keith (1984): Sectoral patterns of technical change: Towards a taxonomy and a theory	71
von Hippel Eric (2006): Democratizing innovation.	71
Appendix A: Statistics on world banking transactions	77
Appendix B: Mind map of German FinTech companies	80
Appendix C: List of companies working on biometric authentication	81
Appendix D: List of Blockchain companies	82

Table of figures

- Figure 1: Visualisation of unbundling in banking - Source: cbinsights.com 4
- Figure 2: Most innovative companies 2016 - Source: Fastcompany.com 11
- Figure 3: Contactless technology - Source: Diebold.com 13
- Figure 4: WeChat monthly active users - Source: Tencent report 19
- Figure 5: FinTech start-ups in Europe - Source: Letstalkpayments.com 22
- Figure 6: How Blockchain works - Source: Qinsights.net 27
- Figure 7: Visuals from Simple, Number26 and Fidor - Sources: Simple.com, Number26.eu and Fidorbank.uk..... 34
- Figure 8: Visuals from Santander, Barclays, ING DiBa and DKB - Sources: Santander.de, Ing-diba.de, Barclays.de and Dkb.de 34
- Figure 9: Innovators... - Source: Yourreadybusiness.co.uk 37
- Figure 10: Ten types of innovations - Source: Source: Lerry Keely, Ryan Pikkell, Brian Quinn, Helen Walters..... 38
- Figure 11: Cross-broder payment example - Source: Ripple.com 42
- Figure 12: Ripple Technology overview - Source: Ripple.com 43
- Figure 13: Exchange rate and fee for TransferWise - Source: Transferwise.com..... 46
- Figure 14: XRP / € Exchange rate - Source: Coinmill.com 47
- Figure 15: Social shares on blockchain in banking articles - Source: Buzzsumo.com..... 52
- Figure 16: Regulators role in a distributed ledger - Source: Maria Semenchenko..... 53
- Figure 17: Virtual Currency exchangers - Source: Maria Semenchenko 55
- Figure 18: Innovation adoption curve - Source: Jurgen Appello on Flickr.com..... 63
- Figure 19: German Fintech Mindmap - Source: Paymentandbanking.com 80

Table of tables

- Table 1: Bitcoin volume - Source: Statista.com 26
- Table 2: Bank interest rates on new loans to, and deposits from, euro area corporations and households - Source: European Central Bank 39
- Table 3: Interest in Blockchain according to Google Trends - Source: Google.com 51
- Table 4: SEPA credit transfer and direct debit – Evolution of euro area migration (% of total transactions) - Source: European Central Bank..... 62
- Table 5: Ethereum exchange rate - Source: Poloniex.com..... 67
- Table 6: Banknotes and coin in circulation - Source: Bank for International Settlements (BIS) 77
- Table 7: Payment transactions by non-banks: total number of transactions - Source: Bank for International Settlements (BIS) 77
- Table 8: Use of payment instruments by non-banks: number of transactions per payment instrument - Source: Bank for International Settlements (BIS)..... 78
- Table 9: Use of payment instruments by non-banks: number of transactions per payment instrument - Source: Bank for International Settlements (BIS)..... 78
- Table 10: Use of payment instruments by non-banks: number of transactions per payment instrument - Source: Bank for International Settlements (BIS)..... 79
- Table 11: Companies working on biometric authentication - Source: Investorideas.com..... 81

1 Introduction

How can new, promising technologies like distributed ledgers (Blockchain) improve the cost structure of banks and solve digital customer identification problem through multiple channels?

Why should big established banks care about small FinTech start-ups?

These and many more related questions are topic of this Master Thesis.

Banks have realized that, in order to ensure their existence in the near future they have to reinvent themselves, recover as Phoenix from ashes of the old business models, currently based on branches, superiority of the 'Banks as an institution'. Banks, as we know them, will belong to a heritage of artefacts once created by human beings and having stopped in its evolutionary chain.

According to prognoses, till 2025 more than 30% of existing banks will discontinue their existence.

Well, in order to survive the next 10 years (and beyond), banks need a smart survival strategy: realize the need of a change and take actions. It doesn't mean however, that banks should betray or reprint their own DNA. If they try, they will most probably fail. Of course it is a different story, if the banks are created as digital, and from beginning on have customer focus, lean organizational structure and technology driven services and products. Such example on the market like Atom, Simple, Mondo, Fidor, Solaris banks already revolutionized traditional banking models and proved it with a growing number of customers, investors and increasing media interest.

What is a bridge of solvation for big reputable banks and financial institutions? What are the new competitors on the block and which strategy to follow in order to bring the innovation in the DNA of banks business models? There are a lot of disputes and doubts in the media, if ever banks will switch completely to digital forms and can shake off their old images and habits.

Most probably, as Chris Skinner describes in his book 'ValueWeb', there will be a humanized digital bank in the future. It will have a limited number of branches combined with all advanced digital services existing on the market. How banks will find the right balance of personal and digital experience is still unknown.

The good thing is, that there are many thrilling and exciting innovations in the financial sector at the moment, which are available also for banks. Liberalization of innovations in the financial sector gives very promising signals not only for consumers but also for established banks.

One of the indicators, which shows an increasing interest in financial innovations and banking, is the number of investments and funds allocated to FinTech start-ups.

In Q1 2016 alone, the overall amount of investments in FinTech have reached 6,7 billion dollars. An interesting observation is, that among FinTech companies with the biggest funding are 3 companies from China. This shift of innovation to developing countries like Asia, and Africa, will be discussed with examples in one of the chapters of this Master Thesis.

The key purpose of my Master Thesis is to investigate how banks are challenged by new technologies like Blockchain. Whether there is a rational behind a business case for the integration of the Blockchain technology in existing landscape of banks? What are the risks and obstacles on the way to a new Value Webⁱ?

What is the role of regulators in fostering and controlling the innovations on the market? and players on the market, including big high-tech giants and the rising number of FinTech start-ups offering the same products and services as banks but cheaper, quicker and smarter.

And beyond that, how they can deal with these threats (or are the opportunities?) by for instance changing their business model.

Over the last 100 years, banks have been the innovators in the financial sector, but their evolutionary development has stagnated, for whatever reason.

Introduction of credit cards in 1950 or cash machines in 1970 have changed purchasing behaviour of customers. Many banks, like Santander Bank, expanded their empires with aggressive acquisition strategy, swallowing numerous of local banks. Having reached a critical growth, the whole heritage of legacy systems and complex IT designs became an obstacle on the way to reimagining a new business model.

Side note: *At the moment I happen to work at Santander Bank Germany.*

Therefor you'll find throughout this Master Thesis references, examples, etc. to it.

Nowadays banks are catching up with innovations coming from smaller and lean start-up organizations. It is hard to say whether big fish can be eliminated by small piranhas in banking innovation, but for sure small fishes will nibble a big piece of banking business.

One of the trends observed on the financial market is defragmentation of banking services and products represented by Fintech start-ups.ⁱⁱ Defragmentation or how it is mentioned in many literature sources "unbundling" of banking services. When big banks are trying to play on all "frontiers", offering a broad spectrum of services and products, small flexible Fintech start-ups focus on only one product or service and make it perfectly fitting the customer needs. These products from Fintech start-ups are biting single banking products and services in speed, cost and customer experience. One traditional bank can be bitten on the market by multiple single products offered by Fintech start-ups.

Below is an example of unbundling of banking services with small platform based start-ups in financial space.

A nice visualization of unbundling in banking:

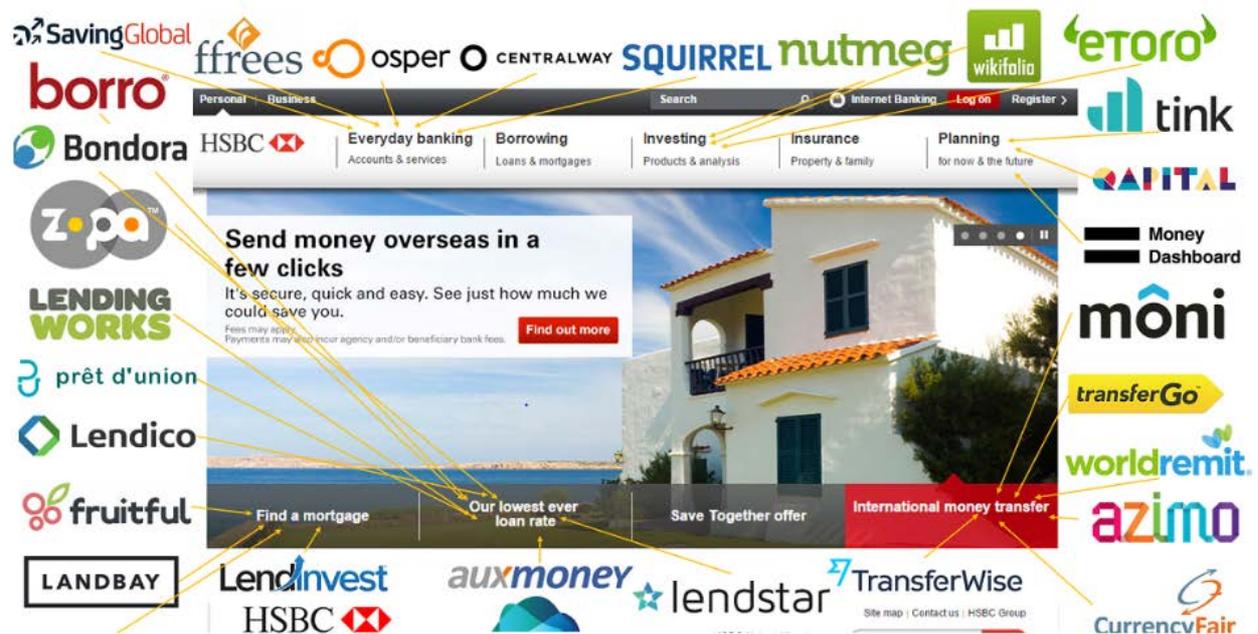


Figure 1: Visualisation of unbundling in banking - Source: cbinsights.com-retrieved on March 15,2016

So, the goal of this Master Thesis is to analyse, if this and other threats coming from the market have to be taken seriously by incumbent institutions.

Innovations in finance are revolutionizing our lives. The future looks very thrilling; just looking at the recent 2 years of new disruptions on the market like robo-advisors, APIs, biometric banking, adoption of Blockchain by banks and financial institutions, predictive and real time analytics, crowd funding and Peer-to-peer financing.

Banks are waking up from a liturgical sleep and start acting. How they can become digital and open banks, is also discussed in this Master Thesis.

2 Literature review

For the literature review I've decided to use a topic-based approach, instead of an article-based approach. Meaning that the below topics, which are important in this thesis, are also leading in the literature review.

With the help of many articles the several topics are described, motivated, etc. The key topics are addressing importance of innovation in organisations and especially for well-established banking institutions, which have their hard times in redesigning and reinventing themselves. Where the biggest threat is coming for banks from high-tech giants, from small FinTech innovators or from banks themselves? What are the new trends on the market banks have to consider and adopt in their strategies? How innovative technologies are differently adopted within geographies? All these topics are very crucial in analysing the current shifts in banking ecosystem and foreseeing the future strategies for banks.

2.1 Why innovations are vital for organizations?

In a discussion paper on strategy and Innovation from Michael Stephan on “Innovation capability, Creativity and Openness as a challenge to innovative companies” management of Innovation is metaphorically compared with Jazz as a music style, embracing improvisation and mix of different styles. Improvisation in Jazz doesn't mean anarchy, but a combination of structural elements and ability to improvise within this structure. It is a mix of known musical part with new elements taken from other musical styles. This metaphorical comparison is very much in line with P. Drucker description of innovation, which is based on old things and new.

Traditional banks have to take example from Jazz music style and let improvisation and experimentation inside of their structures. Structural ambidexterity requires flexibility for the exploration and efficiency for the exploitation part.

There are many approaches investigated in the literature regarding this topic. Simultaneous exploration and exploitation are crucial for the organisation as they help to compensate weaknesses of each other: inertia, caused by exploitation activity and lacking profitability coming from exploration activity (Levinthal;1993). Among organisational attributes positively

related to ambidexterity (Jansen;2009) are informal social relationships, cross-functional interfaces, establishing linkages between exploratory and exploitation activities, senior team social integration.

Unfortunately, banks still have strong formal and distant way of communication cultures within their organisations. Distance and formal relationships contribute to silos within organisational entities and lead to friction of information flows.

Agile development as a way to embrace experimentation inside the organisation

On the way to experimenting with flexibility inside of the banking organisations, one of the concepts has won especial attention in the last years. Some banks created exploratory departments working agile on innovative projects, such example can be seen with the Dutch ING Bank, which successfully piloted in 2012 agile methodology in project development. Since 2015, Santander Bank is experimenting with agile development for selected projects in the bank. The key setting of agile development is based on a close cooperation of teams, who have very clear roles definition in the project team. Product owner, Scrum Master, The scrum team. Each agile project is split into pieces of business requirements, quickly developed, tested and set in the production system. Such short development cycles are called sprints.

The beauty of agile development is in its flexible nature and proof of concept on the early stage. Agile methodology is more applicable to exploration than exploitation activities of the organisation, and can be used for the innovation driven projects.

Innovativeness of a company reflects its adaptability to environmental changes.

It is vital for organisation to observe, analyse, select and change itself.

Literature on the innovation capacity of firms (Neely, Hii ,2012) specifies **3 key determinants** of the firm's capacity to innovate: **the culture of the firm; the internal processes and the external environment.**

Different firms have different innovation capacity. Companies with open, multi-functional teams, strong culture and continues improvement strategy have a higher potential for innovation. On the process level, organisations open for new ideas generated internally and in cooperation with customers, government, suppliers are also tending to have a higher level of innovativeness in their DNA.

It is also important to consider a favourable environment for innovativeness of firms, created by tight cooperation between different industries, supporting regulatory framework in some regions and investors activity.

What are the sources of innovation?

P. Drucker is describing an innovation as a hard, focused work combined with a regular systematic analysis of the opportunities. In his work 'Principle of Innovation', he distinguished between seven sources of innovative opportunity.ⁱⁱⁱ

Among them are the following:

- 2 Observe unexpected success or failures of the organization and unexpected success or failures of its competitors
- 3 All sorts of incongruities in the process, either in customer service, production or distribution
- 4 Process needs
- 5 Observed changes in the industry and market structures
- 6 Changes in demographics
- 7 Changes in meaning and in perception
- 8 New knowledge

Systematic analysis of opportunities is like a muscle, which you can train day by day. Your vision will get sharper in detecting difference in your environment, unmet needs and gaps on the market. Unfortunately growing big companies lose this ability to see opportunities, relying on the old success story. Not every organization has the same ability to reflect on changes and make adjustments of its business model accordingly. Organisational ability to utilise its core competences combined with market opportunities can be a driver company's innovativeness.

Among key dos on the way to innovation according to P. Drucker are the following:

- Simplicity of innovations. Effective innovations are simple and focused and based on the existing knowledge combined with new elements.
- Effective innovations start from small. There is an innovation targeting specific area, not aiming to revolutionize the world.
- At the core of a successful innovation is a role of a leader

Many current solutions in financial innovations are pretty simple.

Example of Kabbage

One of the innovative solutions is represented with a prominent FinTech start-up Kabbage, which combines SME lending with new client's evaluation model. The model is based on variety of customer data, including purchasing, online behaviour. Many banks, reject SME's because they consider them too risky. But the problem is in missing capability of banks to perform a proper creditworthiness analysis of a customer in a short time.

Example of mBank

Another innovation in banking can be seen within a polish mBank, a completely online bank, belonging to former BRE Bank. Customers of mBank can make transaction to their family and friends using Facebook text messages. No account numbers are used; phone numbers are substituting those.

The newness here is in combining traditional banking services with a huge potential of social media. Additionally, it engages a customer in a plug-and-play experience.

Chris Skinner in his' Digital Bank' book describes a story of mBank, which was created as a spin-off of a BRE Bank and at the end managed to cannibalize its mother company.

2.2 Disruptive innovations

The word 'disruption' is used in most of the literature sources related to innovation ever since Christensen introduced it in 1995. Christensen in his book 'Innovation Dilemma' distinguishes between sustainable disruptive innovations and how disruptive technologies can make big companies to fail.

Disruptive innovation is based on a new value creation for a new market. This type of innovations is always related to a high level of uncertainty and risk. This is one of the reasons why disruptive innovations are coming not from big market players, focused on return on investment and profitability. Disruptive innovations are coming from smaller companies, focused on one single area, product or service.

Diversity of targets, what is very common for big organizations, is not leading to breakthrough innovations.

How than big players manage to absorb the innovations? One of the key strategies is to observe small innovation driven organizations and acquire them.

For example, Google is acquiring more than one company each week starting from 2010^{iv}.

Number of total companies acquired is more than 189. Apple starting with its first acquisition in 1988 has acquired since than more than 78 companies^v.

Microsoft having started with its first acquisitions in 1987 has reached the number of 194 acquired companies and has stakes in more than 70 companies^{vi}.

The fact is that acquisition of new disruptive technologies doesn't necessarily mean, that they ever see the light of the day.

Many technologies purchased by big players are forgotten and covered with a dust of years.

Sometimes they have to wait for a new buyer for many decades.

A good example is Microsoft, which was collecting since many years imagery maps and decided to discontinue its activity in-house and rely on external providers in 2015.

As a result, it has sold to Uber Technologies^{vii}, its maps. Uber technologies-is an example of disruptive innovation in services, is working as well as Google and Apple on a self-driving car. In this case Microsoft is not only profiting from the sold asset, but supports Uber to compete with its rival- Apple.

2.2.1 Service innovations

Innovations in services is relatively new and blurred area for investigation and scientific studies. First introduces in 1993 in Miles^{viii} it has been expanding within last years with increased number of open innovation business models, new role of co-creation activities with customers and clients.

Service innovation has a lot of facets and is really hard to describe, because it is spreading and evolving with new technologies, open innovation, user innovation and new business models.

Service innovation can include innovation in services and products, innovation in service companies, industries and firms, innovation^{ix} in processes. Pavitt in his 'Sectoral patterns of technical change' (1984) introduces different categories of patterns of innovations based on origination and use of innovation.

Among those categories there is a process innovation manufactured in-house, but used for other sectoral areas and industries. An example Pavitt is giving in his studies is in chemical industry manufacturing an innovative process for the textile industry. This type of innovation

is belonging to a supplier-dominated type of a firm. With time suppliers transformed into main consumers of innovations developed in-house by manufacturing firms and industries. Growing inter-sectoral cooperation and collaboration strengthened ties between innovation creator and supplier. That was the moment, when customers-suppliers started to voice themselves and impact the innovation creation.

Until 1980 innovation was associated with big capital resources, allocated by companies, which had their huge R&D facilities to make research and innovate and powerful manufacturing facilities to bring the innovation to the market.

Innovations of the 20th century are also associated with technological innovations and not so much with service innovations. Eric von Hippel^x points out in his "Democratization of innovation" to increasing role of the **user innovation**. Democratization of innovation is applied in all areas from windsurfing to software. Von Hippel described a shift of innovation from producer centric to a user centric model. User innovation is having a better fit to users' needs, than an innovation developed by producers on their behalf. Inside of big organizations users are employees bringing innovations in existing processes, where they are personally involved in.

Erik van Hippel highlights a different origin of motivation within users and producers to innovate. Users have a lot of personal involvement in designing services or products for their needs, when producers are aiming to generate profits from selling the innovation.

This aspect of innovation both described by Pavitt and van Hippel, is applicable to banking sector, where banks are still looking inside of their financial factories, ignoring users as important source of innovation.

On the contrary, Fintech start-ups have an underlying idea of their businesses, coming from user innovation, when couple of unsatisfied founders decide to tackle a gap on the market.

Another enabler for innovation within organisation was driven by a shift of manufactories into servitization business models, which represented a combination of a product, bundled into a service.

Many manufacturing firms have realized, that services create an additional value to a customer and bring higher margins, if combined with products, than pure products selling.

The term of servitization introduced by Baines T.S, Lightfoot H.W, Benedettini, O. and Kay J.M. in “The servitization of manufacturing; a review of literature” refers to an innovation in organizational capabilities and processes to create a better value through **selling Product-Service-Systems instead of products.**

The key tasks of servitization are to improve customer satisfaction and quickly respond to customer needs, improve company’s performance with fewer tangible assets involved, stay competitive on the market.

Service innovation nowadays is booming. If we only look at the top 10 innovative companies in 2016^{xi}, we can see, that 4 of them are in pure service innovation (Netflix, Amazon, Uber, Alphabet).

01 BuzzFeed

For shaking up media across the globe

02 Facebook

For not letting size get in the way of acting like a startup

03 CVS Health

For becoming a one-stop health shop

04 Uber

For hustling corporate business

05 Netflix

For giving unexpected audiences exactly what they want

06 Amazon

For evolving from commerce to cool cloud services

07 Apple

For acing its China test

08 Alphabet

For finding a better way to bet big

09 Black Lives Matter

For turning the conversation about race into results

10 Taco Bell

For combining corn, beans, meat, and cheese into genius

Figure 2: Most innovative companies 2016 - Source: Fastcompany.com-retrieved on April 15,2016

Many originally service driven companies like insurances and banks are facing a challenge of reinvention of their businesses.

They are breaking their heads how to inject innovation culture in existing business models? Discussion on innovation strategies for incumbent institutions will follow in the next chapters.

2.3 Innovations in banking in the past and now

2.3.1 Innovations in banking in the past.

Banks have played a very important role in the past in facilitating trading operations, creating transport networks between cities regions and continents, in business development and in innovation. Among biggest innovations, which have radically changed financial sector in the past is the introduction of credit cards, cash machines, banks agreement upon SWIFT usage, exploration of new channels via mobile and internet.

Credit cards

Among biggest innovations in the past driven by banks is an introduction of unified payment form -credit card. Credit cards were first introduced in 1949 as a Dinner card, enabling to pay in many places with one card. During 50s many banks were issuing their own cards, among them BankAmericard-future Visa card was introduced by Bank of America.

In 1966 Bank of America licensed other banks to issue BankAmericard. Since 1976 BankAmericard was renamed into Visa card.

Cash machines (ATM)

Cash machines belong to biggest innovations during the last 50 years. First experiments with cash machines go back in 1961, when City Bank installed its first cash machine in Ney York. It was however not embraced by consumers and in less than half a year had to be dismantled. At the same time an inventor Shepherd-Barron inspired by a chocolate dispenser machine created a De La Rue machine, successfully purchased and installed by Barclays Bank in London.

The first modern cash machines, known nowadays as an ATM was created in cooperation between IBM and Lloyds Bank in 1972. ATM's since than revolutionize the banking sector and enabled people to get access to their money independent on their locations.^{xii}

An interesting thing is, that ATMs from 2016 perspective evolved together with other technologies.

A new trend in cash machine technology is a headless, pinless and cardless ATM. An innovative company in ATM solutions, Diebold introduced such contactless technology (Irving), controlled and steered with a smartphone, supported with biometric authentication.^{xiii}



Figure 3: Contactless technology - Source: Diebold.com-retrieved on April 21,2016

SWIFT (Society for Worldwide Interbank Financial Telecommunication)

An interesting phenomenon in banking innovations is, that its success is only possible, if many participants are adopting the innovation. Such example besides adoption of VISA and Master cards is a SWIFT network of financial institutions, enabling worldwide receiving and sending of messages in secure mode.

Most of interbank operations are done in SWIFT. SWIFT was founded in 1973 in Brussels and was supported by more than 239 banks in 15 countries. SWIFT enabled setting up a standard in financial transactions.

Currently more than 11.000 financial institutions in 200 countries are communicating with each other via SWIFT.^{xiv}

Online and mobile banking

Banks have been always interested in the recent technologies and possibilities, not always however they were brave enough to be among the early adopters of the innovation.

Internet age and introduction of mobile phones have changed the business arena from real life to a virtual, online presence. Banks moved into a mobile virtual branch in order to follow their digital customers.

Internet promised a lot of options for marketing and advertising of banks services with a broader audience reach.

Rapid growth of e-commerce supported the move and opened a lot of possibilities for financial institutions to support online operations, increase profit margins and apply online marketing.

Online banking offered customers to be more self-sufficient in organizing their finances via banks web interfaces. Online banking created for banks a possibility to bundle their products and servicing in a smart way. In the mid of 90s most of banks established online banking strategies and enjoyed a growing customer base.

Another channel, where financial institutions started to offer their services was a mobile phone. Since the first mobile phone from Motorola was introduced in 1983, it took more than 15 years till mobile phones have reached a broader number of consumers. The earliest mobile banking service was an SMS banking.^{xv}

Later on introduction of smartphones using WAP^{xvi} has created a possibility of mobile web usage by European banks in 1999. Mobile banking was done via SMS or mobile web for almost a decade until Apple introduced its legendary iPhone with an Android operational system. Rapid adoption of Apple's iPhone has contributed to a growth in apps, downloaded to client's devices.

2.3.2 Innovations in financial sector now

Banking crisis of 2008-2009 starting from USA created a domino effect within all geographies, which were involved in international banking.

Bankruptcies followed with a loss of trusts within consumers towards financial institutions. Banks 'image and reputation was on the floor, many customers lost forever their money. Since that period banks were under a strict revision and control in terms of equity capital reserves and potential liquidity risks. European Central Bank together with ten countries created famous Basel II requirements in order to protect internationally active banks from financial shocks, when capital markets create a big disturbance in economy.

Innovations, driven by banks, paused for many years because of new regulatory framework. Banks had to reduce their capital in turnover for the amount required for reserves. Investment capacity in innovation was drastically reduced after the crisis.

Financial crises created however an environment favourable for other companies from non-banking sector to enter this sacred area of white collars.

Innovation is like a never-ending stream, if it is blocked in one place, the stream will find the way to overcome an obstacle and come out in an unexpected gateway. An existing demand for banking on the market and untouched by regulators grey zone of financial area, have pushed newcomers to enter the market.

Even now more than 8 years after the crisis traditional banks are taking very conservative decisions towards customers. This leads to a big number of unbanked customers, which are hungry for financial services. Where there is demand, there will be a supply. The supply comes from new entrants, either technological giants like Apple, Google, Alibaba or numerous start-ups from FinTech space.

FinTech became a new bridge of solvation for the whole banking industry, promising to improve user experience with digital services, customer centricity and technological fitness. An interesting observation, is that without regulators, support of innovations in FinTech would not get so far. Regulators play a very important role on the market as enablers of innovations. The role of regulators will be discussed in the Chapter 4 of the Master Thesis.

2.3.2.1 Big giant innovators from non-banking origin

As Eric Allison described the competition “World trade means competition from anywhere; advancing technology encourages cross-industry competition. Consequently, strategic planning must consider who our future competitors will be, not only who is here today.” Borderless knowledge sharing and information flows between industries create favourable conditions for new “marriages”, hybrid forms of business, creating, delivering and capturing new value for the customer.

Big high-tech vs. Banks

Why Google, Apple, Starbucks, Facebook, Alibaba stepped into a banking area with their services and products? One thing all these giants have in common with banks is a huge data collected about their customers. What differs these giants from banks, is that they use this data much smarter, with a lot of analytics and technological support to make the best out of it.

What makes banks feel confident in front of giant competitors is a regulatory stiffness on financial markets, establishing tough entry criteria for both non-banks giants and FinTech start-ups.

Such entry barriers can be a banking license, regulations regarding customer data protection, etcetera; and not to forget trust. Many experts comment on banks’ lost trust among consumers after financial crises shock.

The problem is, that consumers don’t trust non-banks either.

What is the major issue with non-banks giants? Still unsolved challenges with sensitive customer data, security protection from cyber-attacks on digital wallets for example.

2.3.2.2 Absorptive capacity of an innovation by users

Who are the early adopters of non-bank services? It is a thrilling question worth of investigation. From one side, these are digital natives, having multiple profiles in social networks, early adopters of innovative technologies, unbanked customers.

I would like to investigate deeper how is the level of adoption of innovations coming from non-banks. **Key focus: Apple/Google pay, digital wallets, alternative lending.**

When speaking about potential of financial disruptive innovations on the market, it is very often forgotten the readiness of the users to adopt these innovations. Even if there are all necessary conditions for the adoption, the number of people who used the service is still very low.

As the research shows, many are either forgetting about the possibility or just find it not useful enough to substitute a cash or card payments by peer-to-peer or digital wallet transactions.

What is an adoption capacity on the user side? In the battle for nice geeky features high-tech companies neglect absorptive capacity of innovation on the user side.

Why an 80-year-old granny would buy an iPhone, if her usage is limited to outgoing calls? She hardly needs Apple Pay, because she doesn't trust it, doesn't understand its benefit and relies on the old payment behaviour model.

I would not like to discriminate the senior generations in my assumption, because I personally know 80-years old are sometimes adopting innovations and technologies quicker, then millennials.

As well as high-tech companies, banks have to take this important aspect into account, before they go shopping on the innovation bazaar.

There is a lot of critic regarding slow innovativeness of banks nowadays. There are many reasons for that, laying in different dimensions both inside and outside of the banking sector.

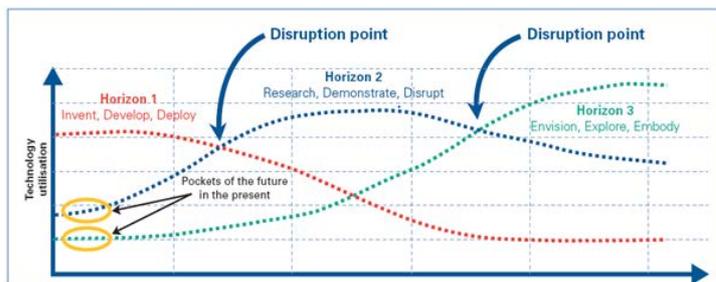
Yes, banks were paralyzed for many years with financial crises and still put their efforts in meeting the regulatory recommendations and requirements on risk minimization.

The problem is also in short-time strategies of banks. If we look at the tree horizon framework, developed by Merhdad Baghai, Stephen Coley and David White in their book

'The Alchemy of Growth' (1999), we can see, that many banks are mainly focused on the first and sometimes on the second horizons in their strategies.

The authors are examining organisational strategies in respect of innovation and growth opportunity. How organisations select new ideas for their further growth.

Here is a visualisation of the three horizon framework in the innovation strategy of the organisation.



Source: <https://paul4innovating.files.wordpress.com/2011/08/three-horizons-visual-journey.png> -retrieved on May 21,2016

The first horizon is related to a current performance of the company and its existing business. The second horizon is related to changes in the environment, which threaten and change existing business. Somehow the **third horizon**, related to a long-term strategy of the organisation is neglected currently. The third horizon is related to sensing and provisioning disruptive changes of the whole industry, based on the '**weak signals**'.

Focus on the first horizon makes organisational strategies reactive and not proactive.

Companies are in this case defending themselves on the market, instead of proactively elaborating on new trends and environment changes.

Living from year to year is not enabling an introduction of an innovative technologies and processes. Banks need sustainable strategy in order to complete their digital transformations.

2.3.2.3 What are the key factors to consider in the innovation strategy?

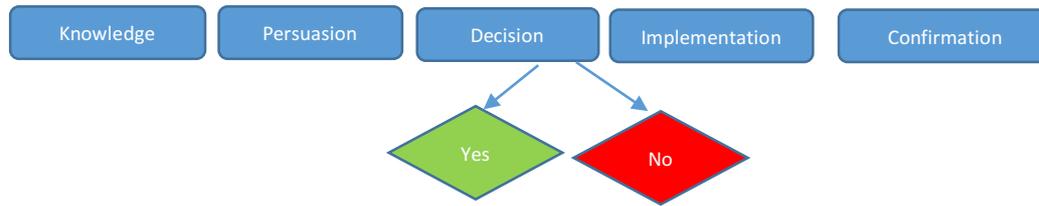
In the diffusion theory (Rogers, 1995) introduces 4 key factors of the innovation adoption by a certain community. Among such factors are the following four:

- Features of the innovation
- Time
- How information about the innovation is communicated
- Nature of the social system, into which the innovation is integrated

An individual innovation adoption according to (Rogers, 1995) depends on the user predisposition to innovation. It means, that from their nature predisposed users are more

likely to adopt innovations on the early stage, than those who are not predisposed.

(Rogers,1995) identifies 5 stages on the way to adoption of the innovation:



These sequence of events on the way to adoption of the innovation is valid also for organisations. Just looking at the current responses of banks to innovations on the market we can see how these factors are fostering or slowing down the adoption. A good example is a hype around digital currencies and Blockchain technology. Increased media attention to these innovations increased the adoption time by big corporations.

2.4 Asymmetry in adoption of innovations in developed vs. developing countries

An interesting thing is, that it seems, that developing countries are better prepared for adoption of new technologies, than developed countries. The Leapfrogging in technology is known and has a lot of examples in developing countries. There are many reasons why some countries adopt the latest innovations on the market skipping the whole evolutionary chain of technology. At the same time evolutionary heritage in technology of developed countries can be a real obstacle and disables of the fast innovation adoption.

Success of WeChat and Alipay in Asia is an example of innovation leapfrogging and quick adoption by users in Asia. As below graph shows, the number of active users of WeChat growing between Q12013 to Q4 2015 almost 3 times, have reached the number of 697million monthly active users.

WeChat from Tencent.



Figure 4: WeChat monthly active users - Source: Tencent report-retrieved on March 30,2016

The same goes for Chinese customers, which are not getting traditional financing from banks. Where there is demand and need, there will be a solution. At the moment only 20% of clients are served by Chinese banks, a big amount of unbanked customers is driving alternative players like Alibaba and Tencent to tackle the problem. As a response, both competitors established digital banks MyBank and WeBank in 2015 not without regulators support, who are offering now private companies to get a banking license.

The thing is, that Chinese government has a big interest to stimulate an economic growth by providing access to finances to small and medium enterprises, which are accountable for 60% of China's gross domestic product and 75% of new jobs^{xvii} Unfortunately, traditional banks are not able to fulfil this goal, because they are providing with lending only big established companies.

MyBank from Alibaba will focus on micro financing of small and medium enterprises in underserved rural market of China. At the moment, both MyBank and WeBank are limited in their actions with an existing banking license. They are not allowed to collect deposits, because regulators didn't allow opening bank accounts remotely using innovative authentication process via face recognition.^{xviii}

2.4.1 How many debit /credit cards are available in China?

As in USA and Europe there is still a strong presence of cards, the switch to mobile banking is much slower than in China, where the switch is from cash to mobile banking. In China cash is still a king. Credit cards are accepted only in hotels, in bigger restaurants, bigger stores or in shopping malls. If you have a foreign credit card, you have to show your passport to verify your identity.

Most of smaller expenses like taxi, open markets and restaurants have to be paid with cash. Knowing this situation, imagine what a disruptive innovation- WeChat payment via messenger, is for Chinese.

Cash vs. mobile phone, it's a leapfrog change skipping credit cards era and landing in the latest mobile finance innovation. UnionPay is the only domestic bankcard organization in the Peoples Republic of China. It exists since 2002 and is the only interbank network of banks excluding Macau and Hong Kong.^{xix} It is linking the ATM's through the whole mainland of China and widely accepted by ATM'S in Hong Kong and Macau. UnionPay is accepted in more than 143 countries and is the third largest payment network by value of transactions processed behind Visa and MasterCard

Statistics on debit card transactions worldwide in 2011 shows, that UnionPay had the first place in terms of average amount per transaction reaching 395 USD p/t.^{xx} The question remains what is the usage of UnionPay inside of China? Unfortunately, it is hard to find any data related to number of transactions and number of cards issued and used within the country.

One of the concepts explaining better predisposition of developing countries to adopting of new technologies is known as "leapfrogging". The assumption is, that it is easier to start from scratch, than to be try to adapt the newness to an existing robustness of structures existing in developed countries. Developed countries have too much of a heritage, which is blocking them on the way to a change. Leapfrogging concept on the micro level of a banking industry is very valid as well, just looking at traditional banks and newly established lightweight digital banks.

Why China leapfrogged from cash to mobile banking? Why not naturally switch to cards transactions, as it has happened in developed countries? Actually developed countries will not switch to mobile finance completely until cards will be abandoned and lose their value in user's eyes. That is another consequence of evolutionary chain of technology.

Traditional banks are prisoners of their organic growth and many acquisitions and mergers. As a result, they created a "jungle" of legacy systems that can't be decommissioned easily and need to be maintained from year to year. How to fight the monster inside of the organization and transform into a digital formation? Is it possible at all? How long banks can take to complete the task and where they have to focus on? All these questions are valid for this Master Thesis and should be taken very careful under the loop.

Adoption of new technologies should be justified by high benefits user will obtain. If the perceived value of a new technology is not sufficient, the user will ignore and resist to a change.

2.5 FinTech: a new kid on the block

Speaking about FinTech, I would characterize it as a revolt of young energy on the financial market, redesigning and revolutionizing the whole banking business. It is a big army of customer-focused start-ups, with advanced technological solutions and processes.

The financial crises discredited a lot before spotless reputations of bankers. Lack of transparency, highly- priced services, branch focus instead of customer focus, technological decadence-these are the troubling features of current banks. At least majority of them.

Not to forget also a big number of customers, which don't have any access to finances, because banks see them as risky clients. Among those: students, small and medium enterprises, self-employed, foreigners and most of people without a credit history.

Fresh, innovative FinTech companies give all control to a customer managing his/her finances.

Digital Bank Simple, offers customers via mobile application to set up financial goals and track them instantly. You would like to save budget for a world trip? No problem, every day your application is reminding you how closer you are to your dream. User interactive application is enriched with infographics. Your personal finance analytics transforms seemingly boring finances into a real game. It is easy not only to save, but also to control expenditures, which are grouped depending on category you create.

BBVA Spanish bank is one of the banks, which realized the threat coming from simplifiers and nibblers, and it took sound actions. As a result, BBVA purchased digital bank Simple, online bank Holvi for SME financing and this is not an end. I am sure, there will be more new announcements about new companies joining BBVA bank.

The reason why many big banks are into FinTech: they will never get to the same level as FinTech companies in innovativeness, simplicity, technological performance and last but not least, customer experience.

The idea is, you don't have to be a powerful mediator; it is enough to create a marketplace for peer-to-peer lending as Lending Club, Funding Circle, Prosper and others and bring value to both private lenders and investors.

Changes in FinTech world happen every day and, that is why it is so fascinating to keep an eye on major trends. Among key trends in FinTech are the following:

- Biometric authentication (behavioural patterns, eye iris, voice, finger print, heart beat and many other innovative solutions)
- Robo advisors
- Cyber security
- P2P lending
- Digital currencies and Blockchain technology
- Payment solutions
- Open APIs
- Data analytics
- PFM
- Marketplace

Below is a map of Europe with key Fintech start-ups.



Figure 5: FinTech start-ups in Europe - Source: Letstalkpayments.com-retrieved on May 12,2016

Let's review some of the trends.

2.5.1.1 Biometric authentication

Online and mobile presence of customers created new challenges for companies to identify and protect their customers. Personal data, credit cards information can be easily stolen and used for criminal and fraud activities. Because of this challenge many innovative companies created already different solutions for customer authentication in Internet and on mobile phone.

Biometric authentication is related to very unique customer physiological or behavioural patterns like finger print recognition, iris recognition, voice recognition, facial recognition, recognition of typing, behavioural patterns, heartbeat recognition. In **Appendix C**, there is a list of companies including banks which have implemented or planning to implement biometric authentication solutions.

According to ABI Research, biometric authentication will be adopted by many governments and industries, and will reach by 2021 30 billion market. As it can be seen in the above list of companies adopting biometric authentication solutions, banks are very engaged in this innovation technology. According to experts on the market, one single biometric recognition feature is not secure enough, so a combination of 2 or 3 can guarantee a better security of a customer against fraud and personal data theft.

Only fingerprint shipments according to ABI Research will hit close to two billion by 2021, accounting for an overall growth rate of 44%.^{xxi}

2.5.1.2 Rising importance of artificial intelligence in banking

Robo advisors

Robo advisors is a new form of financial assistance in banking provided online with minimal human interaction^{xxii}. The key purpose of robo advisor is to consult customers about their investment decisions. Robo- advisors in their functions are limited to portfolio management advising, without addressing other financial aspects like retirement planning, cash-flow planning, estate.

In automated wealth management solutions there are many companies from FinTech. Among them are Betterment and Wealthfront. The question is if they will be acquired sooner or later by giant banks or corporations? On the banking side, one example of introduced robo-advisors can be found in Germany within Deutsche Bank. Santander

Consumer is also about to launch robo-advisors for security business, and for sure many banks will follow as it is an enormous cost saving /optimization strategy helping banks to improve their P&L.

Digital assistants

Digital assistants are an extended version of robo-advisors with customized services to customers based on customer geolocation, profile, shopping behaviour, Internet actions.

Chatbots

Chatbot or a chatter robot is a type of conversational agent, a computer program designed to simulate an intelligent conversation with one or more human users via auditory or textual methods.^{xxiii} Chatbots can be very promising for banking sector, as well as robo-advisors, they can completely substitute human-to-human interactions for some processes. Chatbots can be integrated in the chat services of existing social networks like Facebook, WeChat, Slack. Chatbot is creating a machine dialogue with a user and is another step to a self-service banking.

P2P lending

Peer-to-peer lending or P2P is a form of financing organized between individuals or individuals and companies through the online platform, often called marketplace. Lending without banks or other financial institutions involvement it represents an interesting alternative for both borrowers and lenders. Lenders can get higher returns on investment than on saving accounts in banks and borrowers can get cheaper financing in terms of interest rates.^{xxiv} P2P platforms receive a fee for their services including matching of the borrower and checking of his creditworthiness.

The idea is not much different as a home's sharing with Airbnb or UBER. Three stakeholders are involved marketplace, borrower and lender. Solutions are for both mobile and online usage.

The first company in the world, which offered such services according to Wikipedia was Zopa. Zopa is a FinTech company founded in 2005, represents the biggest peer-to-peer lending platform in UK with more than 500 000 customers. Funding Circle launched in 2010

represents the biggest peer-to business lending platform. Funding Circle supports cooperation between private lenders and SME's.

In USA the first peer-to-peer lender Prosper was launched in 2006. Analogy to UK'S Funding Circle, USA is proudly having its Lending Club, offering peer-to-business lending.

Open API's

Open APIs mean **open IT landscapes of organizations**, enabling data circulation between organization and third parties. Open APIs enable banks to benefit from externalisation of innovation and building up a **modular, component based** IT architecture around banking services based on customer needs. IT systems are open for data exchange with external platforms. For example, Google maintains more than 100 APIs, which enable third party developers elaborate based on data Google provides new services. New services are contributing to Googles success story.^{xxv} API's can be used for the customer data aggregation, and with this data creation of a new context and value for the customer. Key competitive advantages banks can obtain with open API's are: speed, innovation, transparency, relevance of data for customers, flexibility.

Digital currencies and Blockchain technology

Virtual currencies don't rely on physical currency and exist in the gaming industry.

Crypto currency is a type of digital token created with a means of cryptography.^{xxvi}

One of the most popular crypto currencies at the time is **Bitcoin**. Digital currencies are used for purchasing goods and services or in wealth management. For example, if a local fiat currency is depreciating in its value, investment into digital currency can save the value of money. Such digital currencies as Bitcoin, belong to decentralized digital currencies, mined by users and not issued by any central authority, like a Central bank.

Blockchain technology will described in the following chapters.

A list of companies operating on Blockchain or other distributed ledgers can be found in in Appendix D.

2.5.2 Bitcoin and Blockchain in the financial sector, is it a trend or here to stay?

Bitcoin and Blockchain a close loop

There is a lot of buzz in the media caused by Bitcoin and Blockchain since Bitcoin's first rapid value increase **in 2013** have reached **up to 1150 USD per 1 Bitcoin**.

As it was mentioned above Bitcoin, is a crypto currency, created on the decentralized ledger so called Blockchain technology. The Blockchain software is an open code, available for everyone. It runs on multiple computers, connected over the Internet via a common networking protocol defined by this same software.^{xxvii}

Among key elements related to Bitcoin are the following:

- 1) A public ledger (Blockchain)-a big bookkeeping open ledger publically available and containing all records since its origination.
- 2) A cryptographic algorithm called asymmetric encryption, used for authorization of transactions
- 3) A distributed network of computer nodes (miners), that verify and validate Bitcoin transactions and write new blocks on the public ledger.^{xxviii}

Number of Bitcoins is limited by the system to 21 million and spread over 100 years. With a growing number of users, it is getting harder and harder to release new Bitcoins. The last Bitcoin is expected to be created around the year 2040. Every new Bitcoin is created when a user finds a new block in the system. The number of Bitcoins generated per block is set up to decrease geometrically with a 50% deduction with each 210 000 blocks, or every 4 years. Until now number of Bitcoins in circulation have reached 15,38 million Bitcoins. During the period Q12010 till Q12016 number of Bitcoins in circulation has increased in 6 times. The below graph from Statista, shows the growth in volume of Bitcoins between 2010 till 2016.

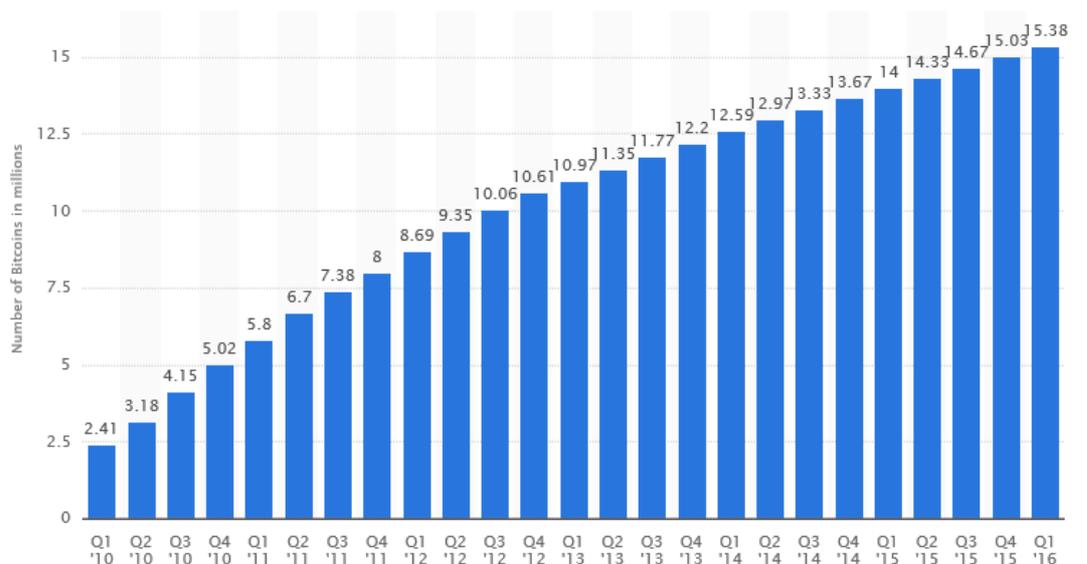


Table 1: Bitcoin volume - Source: Statista.com-retrieved on April 21,2016

How Blockchain works, visualisation:

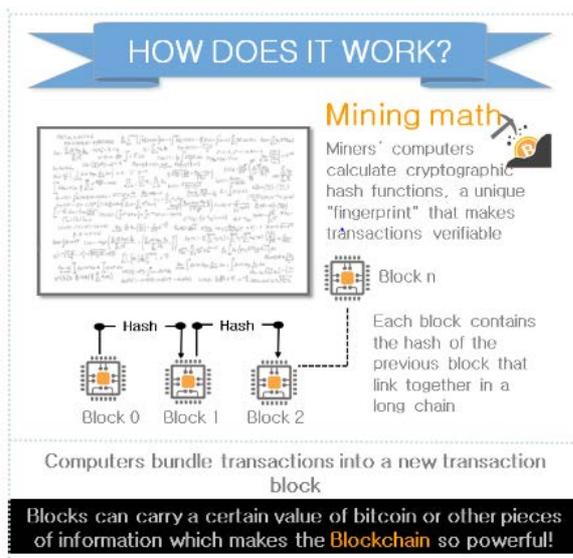


Figure 6: How Blockchain works - Source: Qinsights.net-retrieved on May 5,2016

2.5.2.1 What is mining and how it works?

If in controlled systems National banks are just printing fresh money, in the digital decentralized economy money reminds gold mining, where miners discover it. Discovery of new blocks takes place by distributed computers competing with each other in computer power.

When people are organizing their transactions in Bitcoin instantaneously, the numbers of transactions have to be grouped into a block and added to a genesis ledger-Blockchain. It is the time, when miners confirm transactions, group them into a block and make a new entry on Blockchain.

So, when transaction is done, miners put it through a process. The process is related to converting a block data into a hash. Miners add a mathematical formula to make it happen. The hash is a random combination of numbers and letters coding the block. It is easy to convert a block into a hash but it is impossible to guess what the data is about just looking at the hash. Each hash is unique and is like a unique identity of each block.

Every new hash is created based on the previous block hash, which is way there is a strictly sequential historically traceable list of transactions written on Blockchain. This feature makes manipulation in the historical data impossible.

2.5.2.2 Energy costs related to Bitcoin mining

During mining miners are using their computer power in order to create a block, for their efforts they are remunerated by the system. Every hash is equal -25 Bitcoins. Some compare remuneration with the energy usage for mining.

As Christopher Malmo discusses on the Bitcoin's future perspectives, his main critic is about unsustainable growth of Bitcoin and a big footprint related to Bitcoin mining. In his calculation of the energy costs related to a single transaction in Bitcoin equals 1,57 energy costs per day in American household. If an average number of transactions is around 110 000 per day, energy costs related to a single day on Blockchain would result in energy costs for 172.700 American households per day.

It is 5033 times more energy intensive cot per Bitcoin transaction, than for Visa.^{xxix} If daily consumption for Bitcoin network accounts for daily energy costs of 173 000 households, for Visa the energy costs account for daily energy consumption of 50 000 households.

Actually high-energy costs related to mining, play a role of entrant barriers for random miners.

2.5.2.3 Competition between miners for coins

Many miners are competing with each other on the Blockchain. The one, who is the fastest in creating the right hash out of a block updates a ledger and gets reward. It may take couple of attempts to create the appropriate hash. The protocol is not accepting any old hash. So called 'proof of work' mechanism is making it more hard to create a hash out of the block data.

According to Bitcoinwiki^{xxx}, proof of work is a piece of data, which is difficult (costly, time-consuming) to produce, but is very easy to verify by other users. Generation of the proof of work is a random process, and the probability of using the right one requires many attempts. Bitcoin uses a Hashcash verifying proof of work system. Hashcash is based on the security property of cryptographic hashes, which are designed to be hard to invert. It is easy to compute y from x if $y=H(X)$, but it is hard to compute x if only y is known.^{xxxi}

Before miners take decision to invest their funds in additional mining capacity of their computers, it is recommended to calculate the expected profitability from Bitcoins mining. Key elements of the calculation are: equipment cost, hash rate, current Bitcoin price and power consumption. Another parameter to consider is a network difficulty, which determines how difficult is it to solve one transaction block.^{xxxii}

2.5.2.4 Bitcoins volatility

What is impacting the price of the Bitcoin? Bitcoin price is affected only when it is interacting with fiat currencies or other digital currencies.^{xxxiii} For example if you buy Bitcoins and pay with a fiat currency the price is increasing, but if the salary paid in Bitcoins cashed out in fiat currency, then the price is going down.

Among those, who are putting down the price are the merchants accepting Bitcoin as a payment, miners cashing out for fiat currency, and employees converting salary in Bitcoin in the fiat currency.

The price of Bitcoin is also impacted by media news. If there are more adopters of Bitcoin the price is rising, if there is a negative light given in the press, like discussed connection of Bitcoin to terroristic attacks in France and Belgium, than the price goes down. This volatility is showing public opinion and trust in crypto currency Bitcoin.

There can be a lot of speculations around Bitcoin, whether it is the candidate currency to substitute fiat currency completely. Bitcoin has a lot of advantages, but is full of limitations on the other hand.

Among Bitcoins disadvantages:

- Limited number of Bitcoins up to 21 million,
- It is a very technical currency, and can't be adopted without user friendly modification by a broad number of customers,
- Reputation as a currency used for shadow economy and terrorism
- Limited scalability of Bitcoin
- No buyer protection
- Not many companies accept Bitcoin as a payment
- High volatility

When many Bitcoin evangelists are speaking for digital currency and its benefits for users and organizations, they often forget about key major limitations on the way to mass adoption-its limited scalability. If banks want to mine Bitcoins they have to enhance their computer power capacity and hire specialists in computer science/cryptography. But the problem is how to make it more user friendly and dismantle existing monstrous processes currently dominating in most of the banks?

Why banks are interested in Bitcoin? First of all because it can significantly reduce current transaction costs especially for international operations. Banks will be able to execute million transactions real-time almost for free. Current payment system with major players like SWIFT, VISA, MasterCard are not coping with a new technology, on the contrary they take days and high fees in order to process all number of transactions from banks.

Second valid point for Bitcoins adoption is its underlying Blockchain technology, which will be in detail reviewed in the next chapter.

2.5.2.5 What you can buy with bitcoins?

Even if there is still a lot of uncertainty about Bitcoin adoption by banks, there is in the world quite a number of stores and service suppliers accepting Bitcoins as a currency. The number of merchants is increasing very quickly both in internet and as real stores. You can pay for a wedding honey moon trip in Bitcoin or make a new nose plastic surgery or even get an MBA in Cyprus with Bitcoins.

The spectrum of services and goods you can purchase for Bitcoin is very broad nowadays. The list of merchants and stores offering payments in Bitcoin can be found here <https://coinmap.org/welcome/> based on the geographical location.

Looking in Düsseldorf, Germany I found 4 places accepting bitcoins as a payment method. Among them one book store and shisha store, not bad for the start!

In Cologne a close by city to Düsseldorf, there are 10 merchants offering payments in Bitcoins from babysitting to flirt coaches. An interesting thing is, that there is such variety in businesses adopting Bitcoins. Just for comparison Berlin has more than 47 merchants and 45 in Amsterdam.

One of the most curious stories^{xxxiv} about paying in Bitcoins happened in 2010, when Laszlo Hanyecz offered an English guys 10 000 Bitcoin for ordering him a pizza. Well the price of that pizza now would be suborbital if we count in a current exchange course of 460 USD for 1 Bitcoin. Nowadays the price would be 4,6m for a pizza.

Below some examples of companies accepting Bitcoins as a payment:

- Such big technological giants as Microsoft, Overstock, Dell accept Bitcoins as a payment for their products and services^{xxxv}
- Showroomprive.com-the largest European e-commerce company started to accept Bitcoins already in 2014
- Airlines: Air Baltic, LOT Polish Airlines
- T-Mobile Poland-mobile operator
- MIT Coop Store-Massachusetts Institute of technology, bookstore
- Wikipedia-you can donate in Bitcoin
- Apple Store-it is possible to buy music in Bitcoins
- Bloomberg.com-online newspaper agency
- TechCrunch-IT blog
- Badoo.com-online dating site
- Save the Children-global charity organization
- Holyday Inn in New York announced to accept Bitcoins as a payment for rooms booking

2.5.3 Why banks are looking at Blockchain technology?

Chris Skinner (2016) in his newly published book **ValueWeb** compares Blockchain technology with other innovative mediators like **Uber, Airbnb, Facebook and Amazon**. He is stating, that in financial sector Blockchain can be a necessary vehicle to support value exchange in the real-time and for almost free.

Blockchain has the potential to substitute existing solutions from PayPal, SWIFT, Visa and MasterCard, but not in the next **5-10 years**, as its massive adoption will take some time.

Blockchain has a **unique feature of storing all digital records on the public ledger**, accessible to everyone. It is impossible to manipulate the past records, so the system has a **solid security mechanism based on cryptography and decentralized transactions approval system**.

What makes Blockchain very appealing for banks are its **smart contracts, conditional transactions digitally stored on the public ledger**. You can sign a rental contract with your landlord and store the contract on the Blockchain. This contract you can provide to all governmental institutions, for instance in case you need to obtain a residence permit. Banks can use Blockchain smart contracts in order to store all contracts with the clients, and that way save in physical storage in branches.

The number of banks, started to experiment with a Blockchain technology during the last year only. Santander Bank established a special unit in Madrid in order to gather experience with smart contracts, distributed ledger and crypto currency.

Among banks interested in Blockchain are the following: **UBS, Fidor Bank, Goldman Sachs, BNY Melon, BNP Paribas, Barclays, Deutsche Bank, Societe General, ING Bank, CITI Bank, Bank of Tokyo-Mitsubishi UFJ** and the list is enlarging every day.

Many banks are piloting and experimenting with Blockchain and other distributed ledgers, such as Corda, Ripple in partnerships with Blockchain FinTech start-ups. Some banks however put efforts in developing in-house solutions, like own digital currency created by CITIBANK, 'Citicoins' introduced in 2015 or by Bank of Tokyo-Mitsubishi UFJ, MUFG coin.^{xxxvi}

At the moment their discussion within financial experts which type of the distributed ledger will the banking community adopt for a joint usage.

According to MIT research paper on Blockchain and Financial Services^{xxxvii} there can be several paths for adoption of the Blockchain or other distributed ledger technology by financial institutions:

1) Incumbent Intra organisation permissioned/Private Blockchain: Usage of Blockchain technology in order to eliminate siloes and friction in information sharing between different units, departments. Internal usage as a first step can make the basis for organisational openness to external parties.

2) Incumbent Inter-Organization permissioned/Private Blockchain: Integration of a Blockchain in existing infrastructure and step-by-step migration to it of processes, currently supported by legacy systems.

3) New ventures: funding and cooperation with new ventures, which are already working on Blockchain technology. The best suiting ventures can be selected by incumbent institutions as service providers.

As this technology is in its infancy still, there is no certainty which of above mentioned adoption paths will be followed by adopters. It is very possible, that all of these forms of integration and usage of a new technology will coexist in the future.

Distributed ledgers will connect governments with citizens and institutions in a new way.

As flourishing and promising the technology of distributed ledgers may seem, it is still very immature and is on an early stage of its adoption (inventions and experimentations).

It will not solve all problems of humanity and can't be seen as a panacea for all diseases. There are a lot of obstacles on the way to its adoption, laying in the human nature, organisational stiffness, missing regulatory framework and current technology imperfections.

2.6 Innovation strategy of banks

2.6.1 Digital, Open Bank

The Wall street wears Blockchain or how Big Banks are demonstrating their 'haute couture' innovation strategies.

Nowadays, **innovation strategy** of banks became their **marketing strategy**.

Your credits among community of bankers, financial experts, customers are multiplying if you are developing your own cryptocurrency, testing a distributed ledger technology, introducing new biometric authentication or you successfully implemented Robo-advisers for wealth management.

All this nice features and technologies are the fashion trends of the last and this seasons.

The question is if banks really walk their innovation talks and enable transformations at their cores? Well, it is hard to judge, as all the internal cousin stays behind a very thick layer of curtains.

There is less mentioned in the media at least about the transformation agendas of the high-street banks, besides their innovation experiments, partnering and investment activities.

What makes a bank really digital and open is not only couple of Apps developed for customers, but the whole experience of service delivery by banks. This service experience is just what is laying on the surface and is visible. But under it are processes, human interaction, technology, culture, values and communication layers, which make the bank truly digital and open-the whole value chain!

My experience in the banking sector shows, that the biggest hurdle for big banks is not in technology challenge, but in their organisational culture, disengagement, disempowerment of employees, lack of visionaries and role model managers, who are spreading positive vibes of innovation and change in the company.

Inertia is a killing power of big incumbent institutions, where the knowledge about strategy and innovation is concentrated in hands of a very small circle of people, who are in most cases are very far from the market and customers.

Openness is not only a benefit for the internal communication. Openness to external influences and ideas makes organisations more sensitive to their environment: changes in the customer behaviour, changes in technologies, competitors, regulators.

Open dialogue with regulators, customers, competitors, suppliers can be a powerful vehicle to innovation, elaboration of market standards and joint adoption of such technologies as the Blockchain.

Traditional banks are in less favourable position on the way to digitalisation, than originally digitally created such banks as **Atom, Simple, Fidor, Number26, Solaris**.

What at the end new customers are expecting is an experience of banking! They absolutely don't care about 100 different current accounts or credit cards the banks are offering to them. All these assortment of the same looking products on the menu card is decreasing the appetite of customers to consume it.

Banks at the same time, are trying to sell the customer the 5th credit card in a row, hoping that he will be utilising the limit and paying an interest on that.

An interesting thing is, that Digital banks **like Simple, Fidor, Number26 they even look personal fair, on the contrary to traditional institutions.**

It is not about convincing you with favourable conditions or trying to sell you another product as the other visual with traditional banks websites shows. It is a very clean design with a personalised customer in focus. They show a customer, who is the most valuable asset of the bank and not its 1001 service with hardly any difference.

Some images and visuals from Digital Banks.

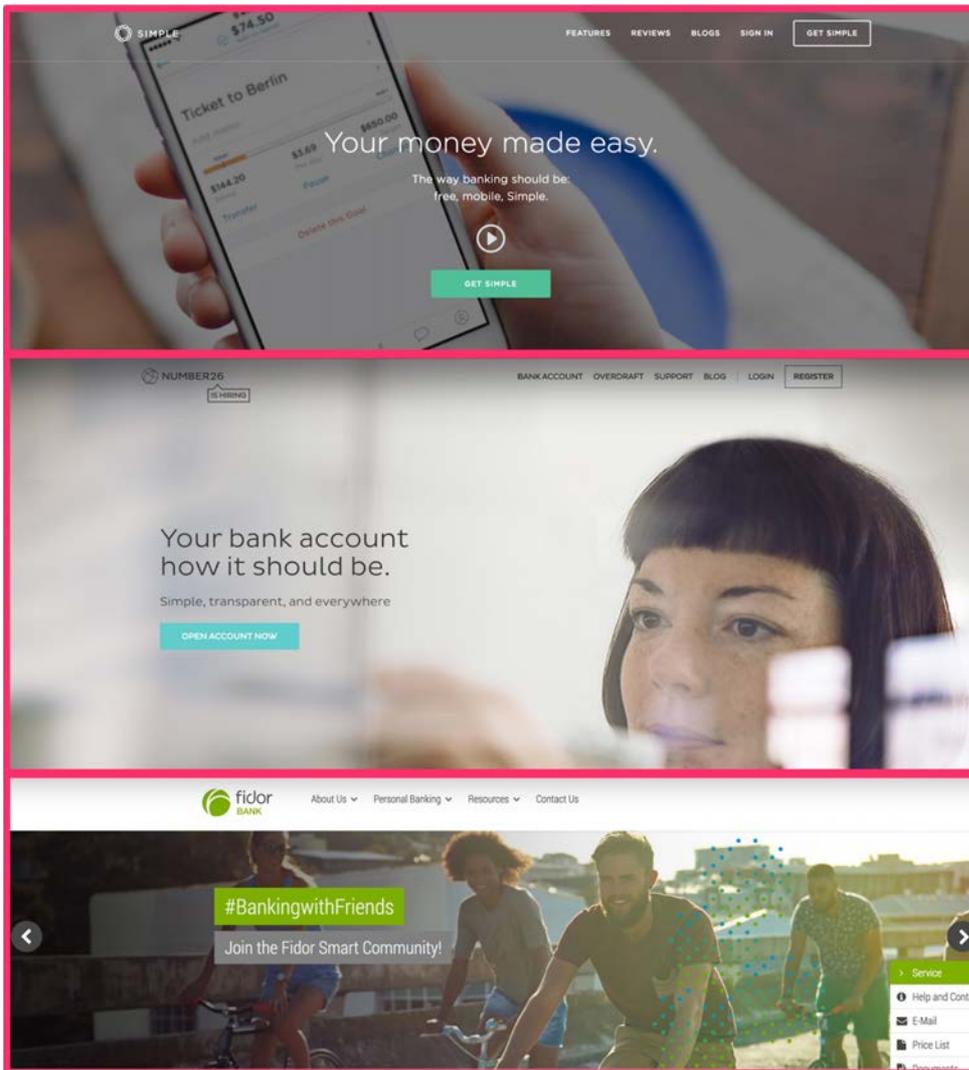


Figure 7: Visuals from Simple, Number26 and Fidor - Sources: Simple.com, Number26.eu and Fidorbank.uk

How traditional Banks are communicating with their customers.

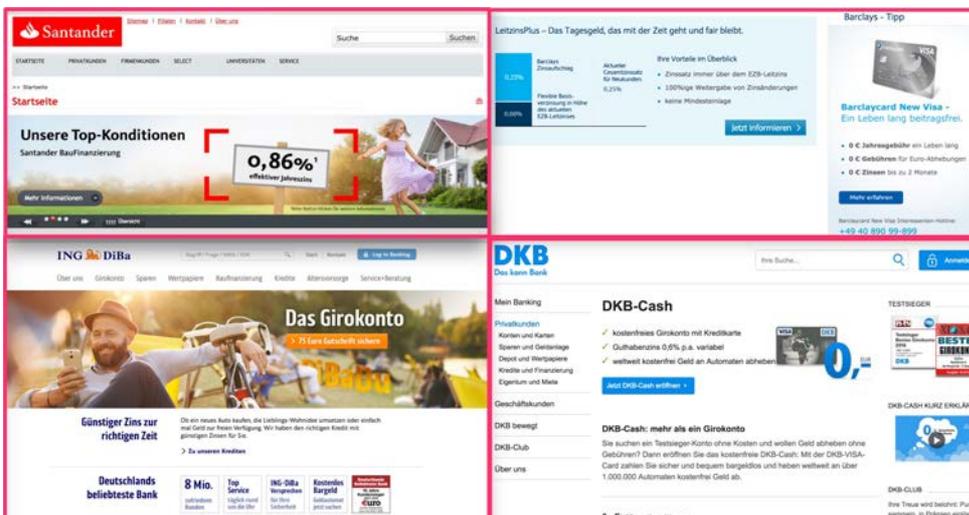


Figure 8: Visuals from Santander, Barclays, ING DiBa and DKB - Sources: Santander.de, Ing-diba.de, Barclays.de and Dkb.de

This simple example in visuals is speaking for itself, where Digital Banks are customer focused and traditional banks are focused on their own products and services, having lost the sense of reality and connection with a customer.

If a generation of my parents and grandparents just didn't have any other alternatives, my generation and generation of my daughter will be choosing their banking services provider based on emotional attachment.

How different are the services from Digital and traditional Banks?

Digital banks offer clarity in tariffs, speed in servicing, they are all technology 'freaks' reachable 24/7, downloadable in the App store and customizable the way you want them to serve you and not dictating your ultimate conditions as their predecessors do.

What about traditional Bank? Can Dinosaurian Banks transform into a Phoenix equipping themselves with a toolkit of fashionable technologies?

The problem is, that they almost all are the same in terms of products, services! Most of traditional banks have a problem related to their brand identity and the way they are presenting themselves on the market. How to stand up in the crowd of peer, who are as impersonal as you are?

The only chance is to refocus on the customer and start building a close and personal relationship with him. Start innovating together new services and products. What does it mean personal? New customers are expecting the products and services as better matching and fitting their need as possible. They expect transparent and clear tariffs and conditions and immediacy in everything.

2.6.2 Shifts in customer behaviour

What banks need to consider as well are general trends impacting customer behaviour and trends in other industries such as:

- Tailor-made services and products.

Example: Nike customized shoes

- Transparency in process, origin, price (Revealing to a customer the whole production chain, proofing origin of the product)

Example: an egg with a stamp of the farmer, where it comes from

- Simple, understandable products and services

Example: IKEA furniture can be built without any preliminary building knowledge of a carpenter.

- Shared things-the value of ownership is a will be compromised. There will be more things shared between people, homes, cars, tools, other belongings.

Example: Airbnb, car sharing

- Lifelong learning
- Peer-to-peer insurance, financings

Example: Friendsurance, Funding Circle

- Immediacy

Example: Delivery of Amazon packages with drones (ongoing project)

Based on these trends impacting other industries, banks have to redefine their offers and services.

With Blockchain technology some of these trends can be integrated for banking, and namely immediate, transparent, peer-to-peer trends. Even if a new technology of Blockchain can solve some of the issues, it can't be seen as a bridge of solvation for organisational stiffness, inefficient operational model, missing leadership, playing the role model for the employees, inadequate corporate culture. These important areas of the company have to be modified, redesigned and reinvented in order to enable consistent transformation on all levels of the organisation.

Changing of the culture however I see as the most challenging part, as it is imprinted very deep in processes, minds, behaviour, communication, collaboration between people. It incorporates collective moral, values, learning which have to be changed.

2.6.3 Innovation as a marketing strategy

Here is how a competition in innovativeness between traditional banks look like.

Are you developing your own distributed ledger?



Figure 9: Innovators... - Source: Youreadybusiness.co.uk-retrieved on June 25,2016

The problem is, that many banks don't really know if this technology will bring them a fame of a 'Digital Bank' or will lead to another fiasco investment.

In case of a Blockchain, **Chris Skinner** is describing ironically, that many top bankers have practically no clue about technologies, they want to incept in the companies.^{xxxviii} There are many use cases for financial application and non-financial application of the Blockchain.

Banks should look deeper in technologies already available on the market as well as they should define which area of the business they want to substitute with a Blockchain technology.

Digital Banks are open and modular banks. With a new PSD2 regulation in Europe, financial institutions will be able to exchange their data with third parties and build components and layers on their existing infrastructures in the first place. With time they have to replace their cores into digital! As **Chris Skinner** stated in his ValueWeb book '**Banks with pre-internet age core systems, have a heart, that is no more beating**'.

It is also important to remember; that **besides technological fitness banks are losing Digital native Banks in business model war. It is essential to redesign, reinvent a business model of banks.**

New business model should fit the bank's identity. As traditional banks have in general quite bad reputation within customers, for example in terms of highly prices services, lacking transparency, it will be a real challenge for them to change this perception and judgement.

2.6.4 Business model

Let's make it clear: distributed ledgers like Blockchain can be a part of the existing infrastructure of banks, and basically this part will stay behind the curtain for the customer. The customer will however profit from a better value delivery through enhanced value chain of the bank in terms of time and cost.

As it was discussed before, shifts in customer behaviour, new competitors on the market with cheaper services and decreasing profit margins of incumbent institutions, will push banks to look at new business models. Some of the components, displayed in the picture below are extremely important to look at for banks: profit model, customer engagement, product performance and processes.

Analysis of the business model applying the Doblin's team framework^{xxxix}, which identifies 10 types of innovation. This model can be split into 3 blocks **configuration, offering and experience**.



Figure 10: Ten types of innovations - Source: Source: Lerry Keely, Ryan Pikkell, Brian Quinn, Helen Walters. -retrieved on June 20,2016

Above model with ten types of innovation was created by Doblin team while examining more than 5000 innovation ions. As a result of their study, they have identified some patterns for successful innovations.

Most successful companies examined by Doblin team, had similarity in their approach to innovation. They focused on a shifts in profit model, customer engagement and on the other hand relied on multiple types of innovation.^{xl} This new business models can't be easily replicated by competitors that way. According to the Doblin team research it is very hard to innovate around customer experience and profit model without touching some other above mentioned types of innovation.

These results can be applied to innovations in financial institutions as well. If banks want to succeed in their digital and innovation strategies, they should focus on

As business model, represents a revenue part in the business case, has to be considered by banks, while deciding to invest in a new technology with a big impact on existing infrastructure and processes.

With existing commoditization of banking services, profit margins are getting thinner and thinner year by year. It is especially visible in consumer banking, where banks earn either on deposits, or on commissions for loans in case of international transactions they apply fixed fees, percentage from the transaction amount.

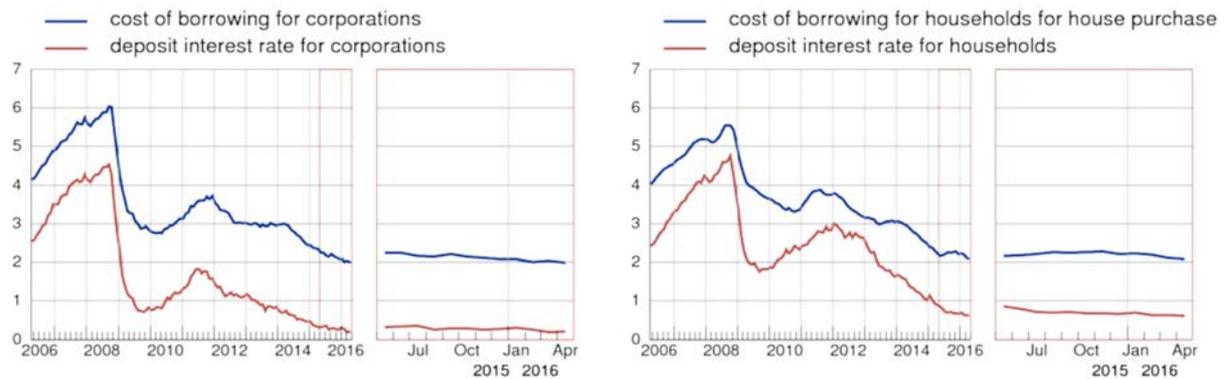


Table 2: Bank interest rates on new loans to, and deposits from, euro area corporations and households - Source: European Central Bank-retrieved on May 23,2016

As it can be seen from the graphs above, from ECB official report, cost of borrowing and deposit interest rate for household and corporations is decreasing since 2011 on the European market.

On the April,2016 the cost of borrowing for the corporations was 1,99% and 2,09% for households, for financing of the house.

As the main focus of the bank will be on mobile banking, their business model has to rely on active mobile/online banking users.

As many banks look at cooperation with flexible and innovative Fintech start-ups, with open APIs customers will be able to benefit from these innovations in the form of customised customer.

financial services. All components in the banking store will be offered by different Fintech companies, with a narrow specialization and focus.

3 Methods

Economics for banks behind the Blockchain technology: as there are a lot of discussions about revolutionary changes for banks with Blockchain technology, I would like to find out and prove some economic benefits, which can be calculated based on existing information and assumptions.

International payments is the area where Blockchain can massively improve performance of banks and reduce the costs for transactions.

Hidden worlds, behind closed doors...

That's probably the best way to describe the situation in banking when it comes to knowledge and technology. The world of banking is in general conservative. Companies are trying to preserve their knowledge and used ways to themselves. That makes it hard also to find any information on the usage of Blockchain and a possible business case for the use of it by banks. The only document I found is related to 'The Cost-Cutting Case for Banks' from Ripple company, published on their official site in February 2016.

Not only the conservative approach of most banks, also the number of unsolved questions related the technology and the way to make it usable / profitable for the financial sector makes it hard to find proper information. Next to that the current business model of traditional banks, immature regulatory framework for the adoption of distributed ledgers by a strictly regulated market are of big impact on the development.

If banks want to use the Blockchain they should carefully define the characteristics of it, because initially it was not made for (traditional) financial sector and is representing a technology in its infancy stage.

The currency

A logical step for banks would be to decide upon a digital currency, that is future proof in many ways (scalable, safe, widely usable, etc.). The currently best known digital coin, Bitcoin, seems to miss some of the future proof characteristics. Its scalability seems to cause issues, since it's hard to mine and its amount is limited to 21 million.

Bitcoin mining is related to exponential rise in energy costs, which is not an option for banks as well. High energy costs for a single transaction with the total number of transactions banks operate in a day will make the whole business model far from profitable.

In 2015 the Blockchain based platform SETL has reached a **1 billion transactions per day**, which is an important milestone, proving the scalability of technology.^{xli} The company SETL is building a private network of distributed ledgers which can settle cash and assets in real time. Number of transactions per second accounts for 5000 and 432 million a day. SETL has proved, that an existing handicap of the Blockchain operating with bitcoins can be solved. For the future it is necessary also to consider a reduced number of operations in cash and completely switch to no-cash form. According to World Economic Forum discussion in 2016, all transactions will be cashless around the world not earlier than in 10 years.

3.1 General information on international payments (cross-border payments)

First of all, let's make clear what a payment system means according to BIS (Bank of International Settlement). **'A payment system consists of a set of instruments, banking procedures and, typically, interbank funds transfer systems that ensure the circulation of money'**^{xlii}.

It includes non-cash instruments covering checks, credit, direct debit, credit and debit cards and e-money. International payments, which are covered by the payment system, represent a cross-border funds transfer either in the form of credit or debit. (see payment order/message definition from BIS)^{xliii}.

Global international payment market is estimated to be worth of 26 trillion USD, of which 5,6 trillion (21,5) belongs to the SME (small and medium enterprises) sector.^{xliv}

3.1.1 AS IS analysis on the current situation with international transactions.

The current settlement process for international transactions suffers from high costs, limited access, big number of errors in transactions, slow process. In average international settlements take 3-4 days, but can take up to one week. For a small-medium bank the process can look the following way:

Bank A from country A prefunds its account/creates a credit line with a correspondent Bank B, which will directly or through a partner provide needed liquidity in a local currency to Bank C from country C.

This process reduces number of nostro accounts in multiple currencies for Bank A. Nevertheless, this arrangement requires many correspondent partners in different countries^{xlv}

Here is a visualization of the AS IS situation

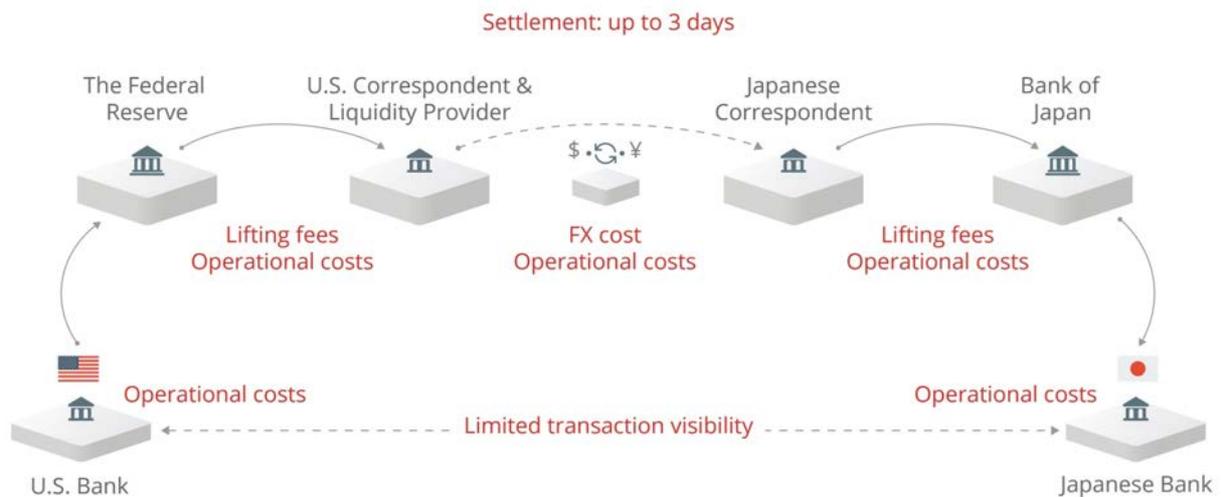


Figure 11: Cross-broder payment example - Source: Ripple.com-retrieved on May 23,2016

The Key problems with the existing process as mentioned above are the following:

Speed: the process takes in average 3-4 days with a wild web of partners, mediators involved in the process.

Cost: many participants in the chain are causing additional charges and fees for FX, treasury operations, payment process.

Errors: big number of transactions and messages between participants of the international payment process increase the probability of errors and failures in the process.

Access: as it is too expensive for banks to have multiple nostro accounts in multiple currencies in order to serve their foreign transactions, they have to rely on correspondent banks. This dependency drives the prices for correspondent banks services high as well as foreign currency exchange rates.

All the above mentioned problems can be solved with Blockchain technology, promising to create a real-time value web transfer for banks, in a secure, auditable, cost-efficient way.

3.1.2 TO BE solution for international transactions with Ripple's technology

Let's look at one of the possible **TO BE** scenarios for bank, in case they will integrate a Blockchain like technology for the international transactions.

Ripple is a company offering distributed financial technology, it allows banks around the world to directly transact with each other without the need for a central counterparty or correspondent. It offers a cryptographically secure end-to-end payment flow with transaction immutability. Ripple's distributed network allows foreign exchange to be externally sourced from a competitive FX marketplace or an internal FX trading desk via Ripple's FX Market Making solution.^{xlvi}

Ripple is using distributed ledger, which is supporting multi-currency transactions and has its own cryptocurrency **XRP**. According to Ripple's cost-cutting analysis, banks can **save up to 60%** in costs related to cross-border payments. The benefits will be increasing for banks with further adoption of the distributed ledger technology by other banks. At the same time Ripple the marginal costs in the long perspective will be zero.

Ripple's distributed ledger, supporting multicurrency offers the following TO BE process design for banks.

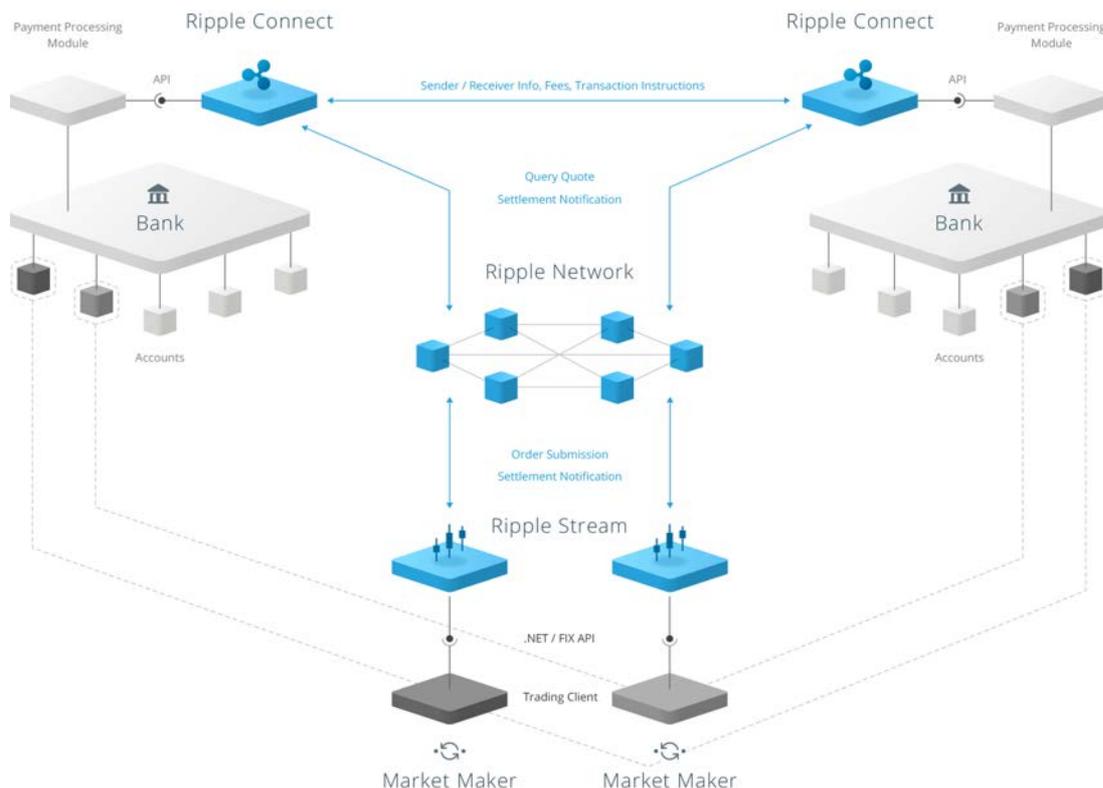
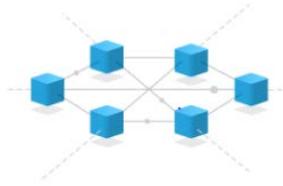
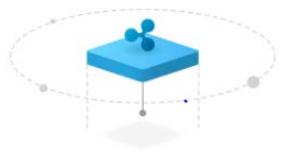


Figure 12: Ripple Technology overview - Source: Ripple.com-retrieved on may 23,2016



Ripple contains the Ripple Consensus Ledger (RLC), which is using consensus process to settle transactions. Consensus of participants on the network, in our case banks, which will be verifying transactions on the distributed ledger has embedded algorithms finding the lowest foreign exchange rate across all order books and currency pairs among payment initiators and market markets.



Ripple Connect is a module that processes international payments for banks. It connects to the receiving bank's Ripple Connect to exchange KYC (know your customer) and risk information, fees, payment details and expected time of funds delivery. It communicates with the Ripple network to get the lowest currency exchange rates. All information about the fees and cost structure is provided to a bank.



Ripple Stream is an interface for market makers to submit bid/ask offers to the Ripple network. Ripple Stream can be used by FX (foreign exchange) trading desks within a bank for an internal market making use case.

The key benefit in this **TO BE** process from Ripple is in the elimination of correspondent banks and the necessity to hold multiple nostro accounts. **The currency-exchange rates will be transparent on the ledger, and will be corresponding the lowest existing proposal between payment initiator and market makers.**

As banks will not be able to set up their own exchange rates, due to transparency in cost structure provided by the distributed ledger technology, they have to rethink how they will be making profits on international transactions, as currently the biggest % from the total profits on international transactions is coming from the spread between banking exchange rate and mid-market exchange rate.

3.1.3 Profits of banks on international transactions

The report^{xlvii} on bank charges for international transactions applied to SME sector in UK has proved, that banks don't earn a lot on the fixed fees for transactions, but on FX (foreign exchange rates).

Total charges including fixed fee for transaction and foreign exchange rates can be **4%** of the total transaction volume. In the research study top six UK banks were analysed with a result of the **Best Bank charging from 0,55% to 3,11% from total amount of the transaction** and the **Worst Bank charging between 3,7% to 3,99% of the total amount of the transaction**. Average fixed fees are varying between **15 pounds for SEPA area** and up to **25 pounds for other countries**.

On the distributed ledger of Ripple, the application of the FX rate will be also decentralised and banks in this network will lose the possibility to play with an FX rate for their benefit. This would mean a big loss of their current profits from international transactions, accounting sometimes for 90% of the total charge for the customer.

This shift in cost structure and execution time should be however very beneficially for the client.

At the moment, there is no official information provided on the sites of banks, which exchange rate they are using for the international settlements of their clients. Normally clients see the total charges couple of days later, when transactions took place.

With the current business model, adoption of the Blockchain technology by banks, will lead to decreased revenues stream, currently coming from the foreign exchange rates applied to international payments.

The biggest benefit for banks related to distributed ledger technology adoption is with improved customer satisfaction and reduced transactions costs. First movers in the industry will differentiate themselves on the market within peers and can improve profitability with new customers.

According to a World Payment Report 2015, global volume of non-cash transactions reaches **357,9 billion in a year**.^{xlviii}

3.2 Innovative solution for international payments in Fintech

As a response to lacking transparency in charges within banks, Fintech company **TransferWise**, established a platform for peer-to-peer international payments within minutes and with real-time mid-market currency exchange rate. TransferWise offers international transactions with 0,5% fees on the amount above **400 euro**. It is possible to install an application and start sending payments **‘fast, fair and simple’**.

If I want to transfer 1000 euro converting to Ukrainian Hryvna, I will pay a fixed fee of 19,61 euro and the currency exchange rate is almost as of the National Bank of Ukraine on that day 1000 euro-27 887,3 UAH (3-euro difference). Deutsche Bank fixed fee for that amount would be 25% and currency exchange spread additionally. Monks are not showing the actual currency exchange rate they are using; a customer can see only when the payment was executed the full amount of charges.

The screenshot shows the TransferWise website interface. At the top, there is a navigation bar with the TransferWise logo, language selection (English), and links for Business, Request money, Help, Login, and SIGN UP. The main content area features a large heading "SEND MONEY WITH THE REAL EXCHANGE RATE" and a sub-heading "Banks hide huge charges when you send money abroad. With TransferWise you save up to 90%. Problem solved, money saved." Below this is a video thumbnail and a link "How does TransferWise work?". On the right side, there is a currency conversion tool. It shows "You're sending exactly 1,000" EUR and "Recipient gets 27,135.87" UAH. A highlighted box shows the "Exchange rate: 27.6787" and "You could save up to: € 25.04 Fee (included): € 19.61". At the bottom of the tool are two buttons: "Compare price" and "Get started".

Figure 13: Exchange rate and fee for TransferWise - Source: Transferwise.com-retrieved on June 6,2016

3.3 Business case calculation

Investment costs in the Blockchain technology for a single participant (Bank):^{xlix}

- For the cost side of the Blockchain technology we need to make assumption, that the cost of integration of exiting systems into a Blockchain is in the first phase (exclusively to support international payments) is **approx. 10 Million euro^l**. **The Blockchain will be exclusively used for mobile/online banking channels.**
- Cost of transaction:
In order to simplify the calculation of the transaction cost, I would take transaction cost on the Ripple distributed ledger, including verification by 4 other banks. The cost equals **0,0005 XRP^{li} or 3cent.**



Figure 14: XRP / € Exchange rate - Source: Coinmill.com-retrieved on May 15,2016

- Let's assume, that we have amortization period of investment within the next 5 years.

As we discussed in the TO BE scenario with the implementation of the distributed ledger technology like Ripple, banks will lose their part of profits on the FX rates. Let's assume, the profits from international transactions will be limited for banks to **fixed fees only**. This profit model corresponds **Scenario A**.

At the same time, as we have seen in example of the Fintech company TransferWise profit model is based on the percentage from the total amount.

For **Scenario B** we review the business case for implementation of the distributed ledger in the bank with a different profit model, similar to its competitor on the market.

Some general assumptions regarding the number of international transactions within an average Bank^{lii}:

- The number of transactions per day is 200 with a respective % distribution (70:25:5)
- The number of operating days in a year 220 days
- Banks international transactions can be split into 3 groups, depending on the amount of the transaction:

- 0 - 10.000 euro (70% of all transactions)
Average amount of transaction:5000
- 10.001-100.000 euro (25% of all transactions)
Average amount of transaction: 50.000
- Above 100.000 euro (5% of all transactions)
Average amount of transaction: 250.000

The above figures apply to the below written scenarios.

Scenario A

With a distributed ledger technology, banks will not be able to make any profits on exchange rates and their profits on international payments will be limited to fixed fees.

Scenario B

Banks will follow the current Fintech companies like TransferWise in terms of international payments. They will setup percentages based fees on the transaction amount. Exchange rates can therefore be minimized.

Based on these scenarios let's make a calculation of the payback period for the investment in the distributed ledger technology. The calculation is based on Ripple technology.

Scenario A (profit model: fixed fee 25 euro, costs 3 cent/transaction)

	years					
	0	1	2	3	4	5
Investment (euros)	10.000.000					
Amortisation		2000000	2000000	2000000	2000000	2000000
Remained amount	10000000	8.000.000	6.000.000	4.000.000	2.000.000	0
Income	1100000	1100000	1100000	1100000	1100000	1100000
Total number of transactions/year	44000	44000	44000	44000	44000	44000
0-10.000 (75%)	33000	33000	33000	33000	33000	33000
10.000-100.000(25%)	11000	11000	11000	11000	11000	11000
above 100.000 (5%)	2200	2200	2200	2200	2200	2200
Volume						
av.5000	165000000	165000000	165000000	165000000	165000000	165000000
av.50000	550000000	550000000	550000000	550000000	550000000	550000000
av.250 000	550000000	550000000	550000000	550000000	550000000	550000000
Transaction costs(euro)	1320	1320	1320	1320	1320	1320
Net income before taxes	1098680	1098680	1098680	1098680	1098680	1098680
VAT (19%)	208749,2	208749,2	208749,2	208749,2	208749,2	208749,2
Net income after taxes	889930,8	889930,8	889930,8	889930,8	889930,8	889930,8
Payback period is 11 years. With a business model based on fixed fees the business case for adistributed ledger is not working.						

Scenario B (business model is based on % from the amount of transaction (0.5%)*

	years					
	0	1	2	3	4	5
Investment (euros)	10.000.000					
Amortisation		2000000	2000000	2000000	2000000	2000000
Remained amount	10000000	8.000.000	6.000.000	4.000.000	2.000.000	0
Income	6325000	632500	632500	632500	632500	632500
av.5000	825000	82500	82500	82500	82500	82500
av.50000	2750000	275000	275000	275000	275000	275000
av.250 000	2750000	275000	275000	275000	275000	275000
Total number of transactions/year	44000	44000	44000	44000	44000	44000
0-10.000 (75%)	33000	33000	33000	33000	33000	33000
10.000-100.000(25%)	11000	11000	11000	11000	11000	11000
above 100.000 (5%)	2200	2200	2200	2200	2200	2200
Volume						
av.5000	165000000	165000000	165000000	165000000	165000000	165000000
av.50000	550000000	550000000	550000000	550000000	550000000	550000000
av.250 000	550000000	550000000	550000000	550000000	550000000	550000000
Transaction costs(euros)	1320	1320	1320	1320	1320	1320
Net income before taxes	6323680	631180	631180	631180	631180	631180
VAT (19%)	1201499,2	119924,2	119924,2	119924,2	119924,2	119924,2
Net income after taxes	5122180,8	511255,8	511255,8	511255,8	511255,8	511255,8
Payback period 2 years. Business case works with this business model much better than in Scenario A.						
<i>* conditions are like of TransferWise company</i>						

As we can see, with a business model, which is based only on **fixed fees** from international transactions banks will need **11 years in order to pay back the investment in the distributed ledger technology. Scenario B is preferable for banks, in case they want to pay back the investment quicker, which is 2 years only.**

Note: **At the same time if a bank has 4 times more transactions per year, the payback period reduces to almost 3 years.**

- Please bear in mind, that the costs are limited only to a transaction fee comparable with a transactions fees on the Ripple distributed ledger, verified by 4 signatures. This amount will be much higher considering other banking expenses related to FTEs, approvals of transactions, administration, marketing costs.
- Integration cost with an existing banking infrastructure can be also higher, than assumed 10 Mio.
- At the moment existing technology is not scalable, more transactions will create additional load on the system, and will drive the cost of transaction higher. This is currently one of the limitations, which is important to solve.
- This simulation shows also, that depending on the number of transactions executed and existing profit model, the business case for the implementation of the distributed ledger can work or not. Banks with small amount of international transactions, shouldn't implement distributed ledger technology for this specific use case.
- Banks have to make proper investigations of the technology, its operating costs, its usability and need for their businesses before they take decision

3.4 Sensing the trend

Observation of the interest in Blockchain and digital currencies

1) Funding graph investments in Fintech (digital currencies/)

One of the indicators of increasing interest in Blockchain and digital currencies is represented with investments in these area.

VC capital

The number of VC investments in digital currency and Blockchain companies has increased from 3 million in 2011 to 474 million in 2015. The number of deals rose from two in 2011 to 74 in 2015. VC investment in Blockchain in 2016 is expected to grow to **10 billion**.

2) Banks are allocating their resources in digital currencies and Blockchain

- 1) Interest from traditional banks to digital currencies and Blockchain technology is presented in number of partnerships with Fintech companies, investments in digital, Blockchain start-ups, development and testing of distributed ledgers alone or in cooperation with other banks (R2 consortium)
- 2) Blockchain technology became a strategic priority of the CEO's of many big banks, looking just where the banks are allocating their resources.

3) Google trend search with Blockchain

Rising interest to Blockchain (2012-2016)

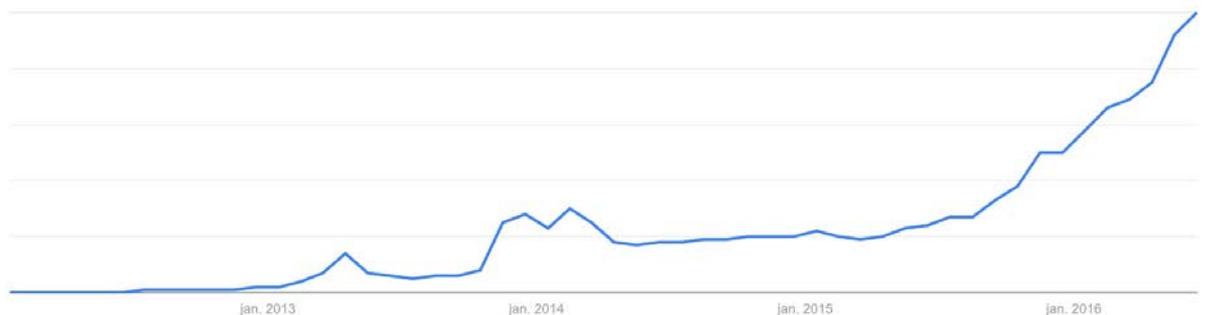


Table 3: Interest in Blockchain according to Google Trends - Source: Google.com-retrieved on June 2,2016

4) References to Blockchain in banking in media

Blockchain in Banking

The topic of Blockchain in application to banking is discussed a lot in social media. People are sharing articles, opinions on this topic in Facebook, LinkedIn and Tweeter.

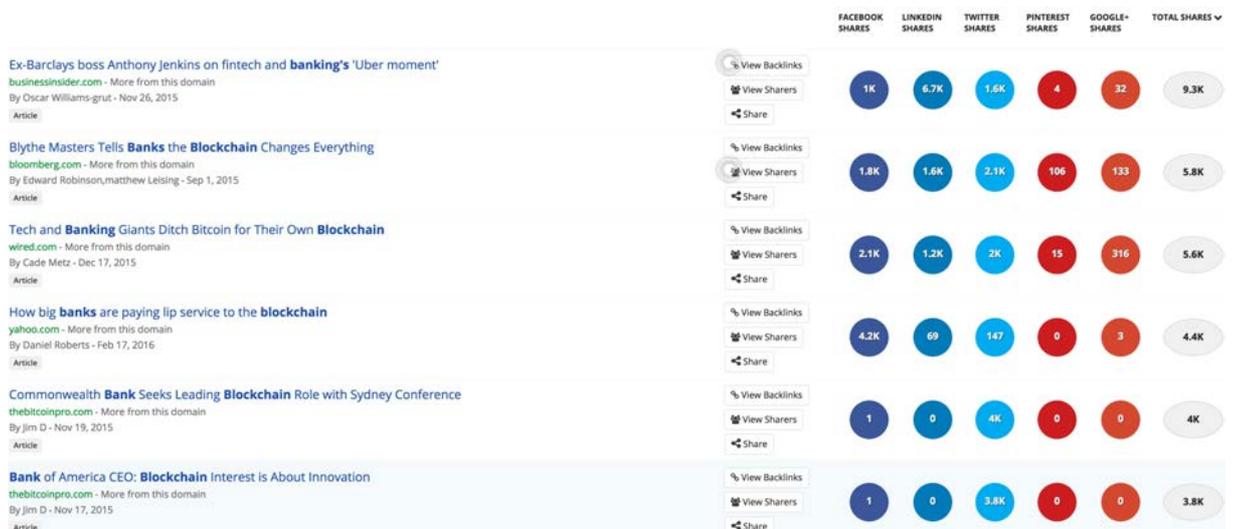


Figure 15: Social shares on blockchain in banking articles - Source: Buzzsumo.com-retrieved on May 4,2016

The topic of Blockchain and digital currencies is escalated within one year between 2015 and 2016. During this short period of time many organisations have managed to integrate Blockchain in their digital strategies.

Even if Blockchain and digital currencies are overhyped, this spot light position in my opinion a powerful enabler to further adoption of a new technology, increase in value of digital currency like Bitcoin. The number of evangelists of disruption with distributed ledgers is rising day by day.

4 Results and analysis

4.1 Regulatory framework, policy challenges (EU, USA, UK)

Who are the regulators and what/how they regulate?

As it was mentioned before, regulators of the banking and non-banking sectors are very interested in the recent innovations on the market. Especial attention is dedicated to digital currencies and distributed ledgers. From one perspective distributed ledgers in banking can make the role of the central authority, executing control, obsolete, on the other hand distributed ledgers and Blockchain technology in particular promise to solve many existing problems of regulators. Among those problems are lacking transparency on fragmented banking/non-banking markets, hardly traceable shadow operations, high operational costs related to control and reporting.

Blockchain technology as an open historically traceable ledger can help not only incumbent organisations but also regulators to follow a fast moving industry.

In the future the role of regulators is discussed also as an observer on the distributed ledger used by banking institutions. Together with 42 banks representatives from regulators are defining and testing different Blockchain technologies within R3 consortium.

The role of the regulators on the distributed ledger in the future.

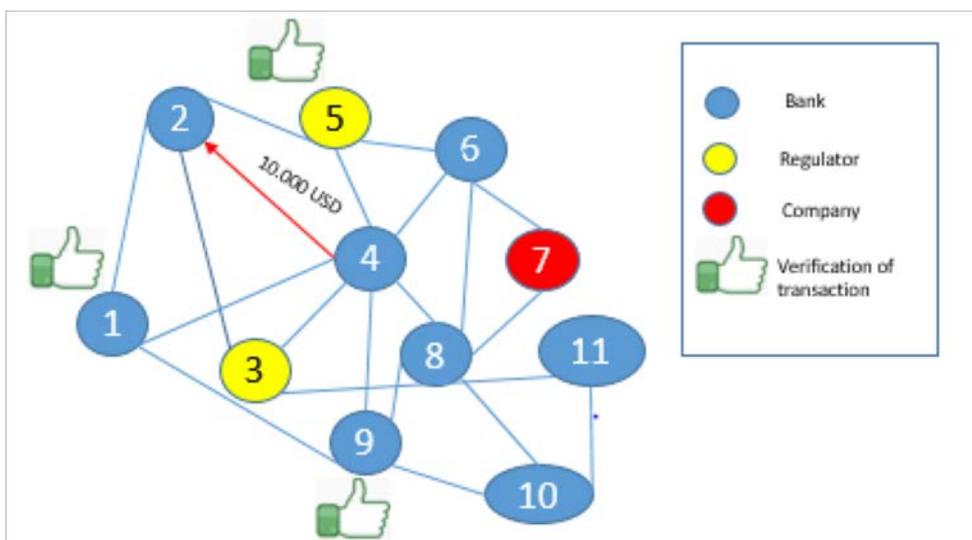


Figure 16: Regulators role in a distributed ledger - Source: Maria Semenchenko

As the Blockchain technology mainly became popular due to its native cryptocurrency Bitcoin. Since couple of years regulatory international and national authorities are following

developments in financial innovation sector and quick adoption of virtual currencies and Bitcoin in particular by different companies, institutions.

At the moment there is no consensus and similar view among regulatory representatives on virtual currencies and underlying Blockchain technology. On the EU level, there is currently no legislation on virtual currencies, however it exists in a fragmented way within Member States.^{liii}Overall this pieces of locally regulations represent a patchwork consisting of warnings, opinions, decisions, supervisions or complete prohibition of virtual currencies usage.

4.1.1 Europe

Below is the list of EU and International regulator, which are following, regulating usage of virtual currencies by financial, credit and non-financial institutions:

1. **EBA-European Banking Authority (guidelines/recommendations on virtual currencies)**

One of the tasks of EBA is to monitor all recent activities on the financial market and adopt respectively the guidelines and recommendations for EU legislators.

In its paper **EBA Opinion on 'virtual currencies (2014)** key 70 risks related to virtual currencies are described with proposed further actions from the regulators side. As a quick response to rising number of virtual currencies in the market, EBA recommends that national supervisory authorities discourage payment institutions, e-money institutions and credit institutions from buying, holding or selling virtual currencies.

2. **ECB-European Central Bank**

As ECB is focused on the field of payments, in its analysis on Virtual currencies schemes (2015) it is stating, that there is no material risk for financial institutions at the moment related to virtual currencies, as its usage in payments is still very limited. At the same time ECB recognises advantages in using virtual currencies, which can be processed with less costs and at higher speed.

3. **ESMA-European Securities and Markets Authority**

ESMA has been monitoring and analysing virtual currencies investments during the last year

In order to understand key market developments. In 2015 ESMA published a Call for evidence on virtual currency investments, encouraging advising and knowledge sharing from the public. Everyone who is investing or offers investment in virtual currency investment products, or those, who use or provide services on distributed ledgers in relation to transactions in securities are welcome to share their experience and advise with ESMA.^{liv}

4. FATF-Financial Action Task Force

The Financial Action Task Force (FATF) is an inter-governmental body established in 1989 by the Ministers of its Member jurisdictions. The objectives of the FATF are to set standards and promote effective implementation of legal, regulatory and operational measures for combating money laundering, terrorist financing and other related threats to the integrity of the international financial system.^{lv} FATF published the report on Virtual currencies in 2014, and in 2015 a Guidance for a risk-based approach aiming to describe potential money laundering and terrorist financing risks, related to **virtual payment schemes**.

What is regulated:

The focus of the Guidance is on convertible currency exchangers, which intersect with a regulated fiat currency financial sector. It is regulating the gateways to regulated financial system and not the users, who purchase virtual currencies for services or goods (see the picture below).

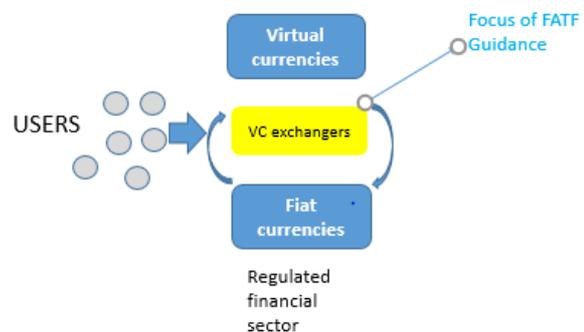


Figure 17: Virtual Currency exchangers - Source: Maria Semchenko

5. **EUROPOL- European Union’s law enforcement agency** whose main goal is to help achieve a **safer Europe** for the benefit of all EU citizens. It is assisting the European Union’s Member States in their fight against serious international crime and terrorism.^{lvi} EUROPOL is involved in investigations related to cybersecurity crimes and usage of virtual currencies like Bitcoin in drugs trafficking, human beings trafficking, trade in weapons and organized terrorism. Trading in bitcoins enables for criminals to

keep their identities anonymous, what makes for official authorities impossible to mitigate the risk of terror attacks financed in bitcoin or other criminal activities.

6. European Commission

After March and November terror attacks on Paris and Brussels supposedly organised by Islamic State-terror organisations and financed via Dark Web platform with bitcoins, European Commission plans to toughen up on the identification for using pre-paid cards.^{lvii}

Pre-Paid cards are not connected to any banking account and can be topped up with cash and can have cards linked to a particular store.

a. In December 2015 the European Commission proposed a directive aiming to criminalise financing of terrorists. Later on in February it has adopted an **Action plan to strengthen the fight against terror financing**. Key focus of the Action plan is on tracking and hindering financial movements related to terrorist's funds and assets.

b. **Fourth Anti-Money-Laundering Directive, adopted in May 2015 will include virtual currencies into its scope.**

c. **Extended Payment Service Directive (PSD2)**

There is a lot of speculations and discussions around adjusted Payment Service Directive and what impact it may have on the banking sector. The key focus of the Directive is on creating a single payment market in Europe. Adjusted regulation is opening new possibilities for disruptive payments in Europe.

What is regulated: (new features):

i. **Access of third parties to banking accounts**

Starting from 2018 Banks will be able to share their data with the third parties via open API's (Application Programming Interfaces)

ii. **Multi-accounts holders (in different banks) will get access to all their accounts via single platform**

Directive will contribute to establishing of a single place/platform for multi-accounts holders.

iii. Customer authentication requirements

PSD2 is setting an obligatory requirement for customer authentication within service providers in Member States (EU). Authentication is required in the following cases, when the payee^{lviii}:

- (a) accesses its payment account online;
- (b) initiates an electronic payment transaction;
- (c) carries out any action through a remote channel which may imply a risk of payment fraud or other abuses.

***Interpretation:** Authentication is also applicable as we can see for electronic payment transactions, meaning also virtual currencies are regulated within this Directive. Service providers offering payments in virtual currencies including Bitcoin, should verify their customers' identity with respective identification documents.*

4.1.2 National levels

On the national level there is a broad range of actions taken from regulatory authorities regarding virtual currencies from no action to complete prohibition.

In the EU many central banks and regulatory authorities have published warnings in order to signal to financial institutions, but mainly to consumers, which risks are related to virtual currencies. Besides illegal activities financed with virtual currencies (Bitcoin), there is a high risk for consumers, that their digital wallets with virtual currencies are hacked, their personal data is stolen or that they are involved in some fraudulent activities like Ponzi schemes. EBA in their warning on Virtual currencies identified more than 70 risks associated with virtual money.

4.1.2.1 Germany

German Federal Supervisory Authority (BaFin) has characterized Bitcoins (virtual money) as a form of financial instrument, similar to a currency, but which is not an officially regulated payment method.^{lix} Bitcoin according to BaFin is not a sort of e-money, as it is lacking a central issuing authority. In its warning BaFin addresses risks related to fraudulent activities of some virtual currency providers, security issues, related to hacker attacks on providers' platforms and sites.

Which activities in virtual currencies (Bitcoin) require BaFin permission?

- No permission is required for customers/provider, which are buying or selling services or goods using Bitcoin as an exchange currency.
- No permission is required for single mining of Bitcoins
- Permission is required for regular purchasing and selling activities
- Permission is required for Mining-Pools which are mining for their commercial purpose
- Multiple permissions are required in case a Bitcoin is a trading currency on a Bitcoin Platform.

4.1.2.2 France

French Central Bank, Banque de France investigating together with Financial Stability Board (FCB) possible applications of the Blockchain technology and its impact on the banking sector. In its recent report Financial Stability in Digital era, Banque de France admits, that 'decentralised trading platforms driven on Blockchain could change conditions in which central banks execute their duties. Such models could replace the operational procedures of traditional clearing houses'^{lx}. It is also stated in the report, that this technology is in the experimenting stage and a lot of conditions have to be fulfilled before its broader adoption.

4.1.2.3 Netherlands

Central Bank of the Netherlands, De Nederlandsche Bank (DNB) is stating, that virtual currencies are unlikely to substitute in the near future traditional currencies.^{lxi} In 2014 DNB has published a warning to banks and payment institutions regarding integrity risks, associated with virtual currencies. DNB qualifies virtual currencies as products with a high risk profile, as they are often traded anonymously.^{lxii} Nevertheless number of open discussion sessions organised by DNB on virtual currencies and Blockchain technology shows a rising interest in the topic. IN the annual report from 2015, Blockchain technology is described as a very promising.

Blockchain technology may impact banking sector business models, but banks may also benefit from new ways of generating turnover and reducing costs. DNB previously pointed out the risks of the use of virtual currencies such as bitcoin, but now recognises the opportunities offered by Blockchain technology. Issues including governance and risk

mitigation should, however, be further investigated, as well as the possible necessity for regulation.^{lxiii}

4.1.2.4 Italy

Central Bank of Italy, Banca d'Italia, besides warning on virtual currencies in 2015, it declares virtual currency exchanges are not obliged to report in terms of anti-money-laundering.

'In Italy the purchase, use and acceptance of virtual currency must be considered a lawful activity: the parties are free to transact in amounts not expressed in legal tender.'^{lxiv}

In Spain in Ireland Bitcoin and virtual currencies are not considered as legal currencies, as they are not issued by the central authority.

In Finland and Estonia however virtual currencies and Bitcoin in particular are a subject to taxation in case capital gains are obtained from transactions in Bitcoin or other virtual currencies.

The Danish tax authority has declared in 2014, that invoices can't be written in Bitcoins, but have to include only legally accepted currencies. Bitcoin losses are not tax deductible.

Among countries which completely prohibited any activities in Bitcoin within official financial institutions are Russia and China.

4.1.2.5 China

The Peoples Bank of China was forbidding the usage of bitcoin by banks, but it is not prohibited to use it for private purpose. Among people bitcoin was very well adopted, as it was the way of payment for US products. Among companies accepting payments in Bitcoin are Dell, Amazon, GAP, Microsoft, Expedia, Tesla, PayPal/eBay and many others.^{lxv}

4.1.2.6 Russia

In the Russian Federation a draft of the document on 'Money surrogates' was submitted to Russian Parliament, Duma end of 2015. This new regulation on virtual currencies including Bitcoin, or as they are called **money surrogates**, will ban dissemination of information on the issuance of money surrogates and the operation on them. As the final document is not

published, the Minister of Finance is suggesting that for cryptocurrencies use, there should be 7 years in prison introduced^{lxvi}.

Nevertheless, an interest in cryptocurrencies and especially in the Blockchain technology is rising on the market. According to **Vadim Kalukhov**, Head of newly established Department of Financial Technologies, Projects, and Process Organization of the **Bank of Russia, Central Bank is not only following all developments in the Blockchain space in other countries, but also launched a study in order to look closer at the technology itself.**^{lxvii}

At the same time a **payment operator QIWI** in Russia announced, that it will launch in autumn 2016 a cryptocurrency developed in Russia. A Blockchain technology will be a basis for a **new cryptocurrency BitRuble.**^{lxviii} According to QIWI'S General Director Sergey Solonin, it is impossible to finalize the launch without official approval of regulatory authorities. It means, there should be a compromise found between interests of business.

4.1.2.7 United Kingdom

The Government of UK before introducing any laws on virtual currencies, published a call for information in November 2014 in order to gather expert views on this topic. The call for information received 120 responses, coming from different public who use digital currencies, develop the infrastructure, banks, government departments, digital currency service providers.^{lxix}

In the summary document containing all responses and opinions, the government of UK states, that distributed technology has significant promise for the future as an innovation in payment sector.

'The government wishes to foster a supportive environment for the development of legitimate businesses in the digital currency sector so that the UK can see some of the benefits of digital currencies, while also creating a hostile environment for illegal activity.'^{lxx}

After the referendum in UK, it is still unclear, what will be the impact of the Brexit on the innovation activity on the market and consequences for the Fintech area. UK Fintech companies have now to apply for EU licences in order to operate on the EU markets. The higher the level of dependence of the firm's model has on EU, the higher probability a firm will choose to relocate for licencing purpose.^{lxxi}

4.1.2.8 USA

In US bitcoin and virtual currencies are treated as a property. Rules applied to the taxation of the property are applied also to losses and gains in bitcoin and other virtual currencies example wages of employees are taxable or a payment made in virtual currency is a subject for reporting as well as any other payment made in property.^{lxxii}

In 2013 SEC-The Securities and Exchange Commission has published its alert to investors pointing to possible Ponzi schemes using virtual currencies. In its paper **Ponzi Schemes Using Virtual Currencies**^{lxxiii}, SEC addresses a possibility of fraudsters to be attracted by virtual currencies as they have greater privacy benefits and are less regulated than conventional currencies.

In 2014, The New York State Department of Financial Services has introduced the most advanced regulation on Bitcoin and virtual currencies a **BitLicence**. This licence is aiming to help protect consumers from illegal activities of digital currency companies, exchangers and others. This licence reminds of a banking licence, setting very high standards in terms of KYC (know your customer), AML, security and customer protection.

These high standards for BitLicence pushed some bitcoin start-ups to exit the New York State and search their luck in other states of the Unites states.^{lxxiv}

All diversity in treatment of virtual currencies in different jurisdictions creates a big challenge for regulators in setting up standards for cross-border activities and operations.

This diversity will encourage entrepreneurs, big corporations adopting virtual currencies to move between geographies, searching for favourable conditions for their businesses.

Markets where the regulators are fostering innovation will be attracting big amount of new players, bringing jobs and capital with them.

I can compare it with diversity in tax policies on different markets, and the impact on the business concentration in some regions. For example, Ireland, having favourable tax policy, attracts big innovative corporations to set their offices in the country and that way there are new jobs created in the region. Irish low 12,5% of corporate tax law attracted more than 700 US companies in the last two decades. Among these new players- big corporations as Intel, Boston Scientific, Dell, Pfizer, Google, Hewlett Packard, Facebook and Johnson and Johnson, Apple.

Only during last two decades' Irish government profited from US direct foreign investment accounting for 277 billion of USD dollars^{lxxv}.

All in all, the regulators are playing a difficult role in protecting and supporting the innovations at the same time. They are following financial innovations and trying to formulate opinions, warnings, restrictions. Financial innovations can bring a lot of benefits for their users and the same time contain a lot of risks and uncertainties.

As there is a delay normally between establishment of a new practice and responsive actions from the regulators, it takes years sometimes till regulators analyse and evaluate in depth new financial innovations and publish any regulative documents.

Close cooperation with innovative companies, institutions, users can reduce the response time of regulators to new innovations on the market.

4.2 The roadmap of the Blockchain technology

Technology adoption, comparing to SWIFT adoption and SEPA

Blockchain adoption by financial institutions can be compared in terms of the impact and significance of change for the banking industry with implementation of SWIFT and adoption of SEPA standards for payments in Euro zone. Image below shows a gradual adoption of the SEPA standards by banking institutions between 2008 and 2013 and the level of credit and direct debit accounts transfer to SEPA.

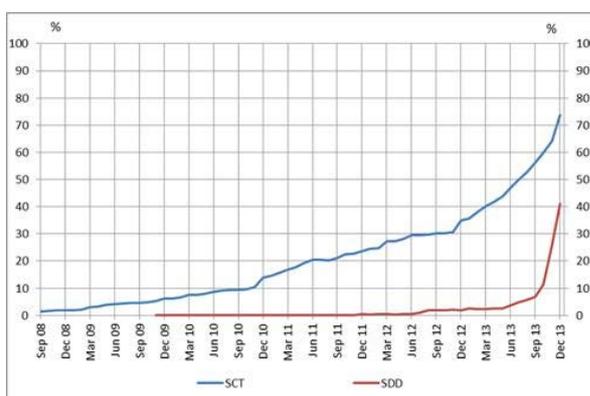


Table 4: SEPA credit transfer and direct debit – Evolution of euro area migration (% of total transactions) - Source: European Central Bank-retrieved on June 21,2016

If we apply an innovation adoption curve we can observe, that early majority adoption for SEPA happens for credit transfer in 3 years after the introduction and for direct debits in 4

years. Please bear in mind, that in case of SEPA payment standards, there is a harmonised legislative framework for all participants of the Euro zone.

Another example, of collaborative efforts and adoption in the banking industry can be illustrated with establishing of SWIFT international payment standards.

Going back in the history we can identify couple of important milestones associated with SWIFT adoption by the banks.

So let us analyse how the evolution of SWIFT took place. From foundation in 1973^{lxxvi} till the SWIFT standard became fully operational and was opened to third parties in 1987, almost 14 years have passed. Nowadays after almost 35 years since it's foundation, SWIFT is an official standard of messaging and international transactions between financial institutions. In 2010 SWIFT linked more than 9000 financial institutions in 209 countries and territories. Number of messages exchanged back than between participants accounted for 15 Million messages per day.

Looking at the adoption curve of SWIFT by the banking community, it took more than **14 years** till the tipping point in adoption has taken place. The tipping point, is the edge between early majority and late majority of users. The year 1987, when other financial institutions were allowed to joined the SWIFT system I would consider as this tipping point. As the time for innovation adoption is now shortening, I would expect less than 14 years, for the Blockchain technology adoption by the banks. As the below image of the innovation adoption shows, the tipping point is reached with the 34% of adoption by users.

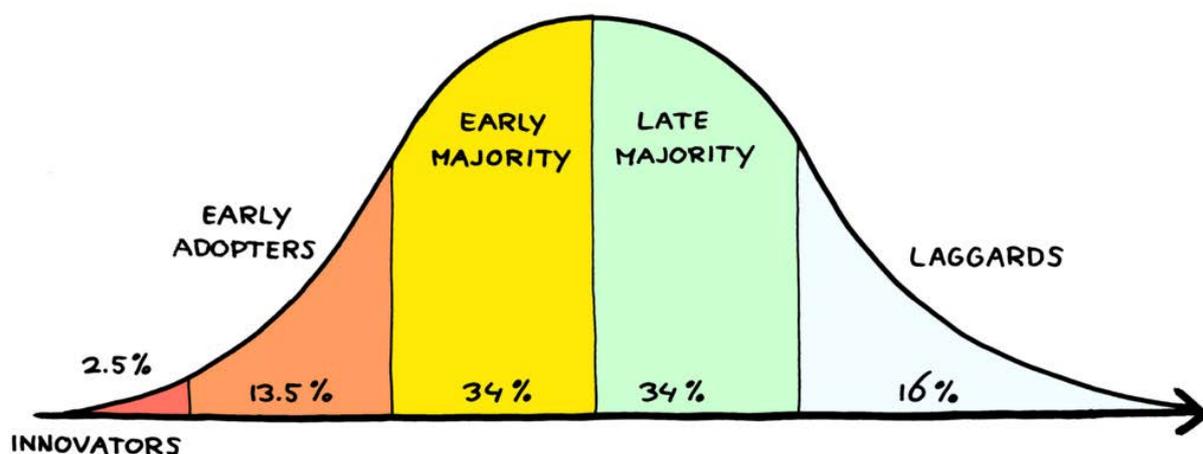


Figure 18: Innovation adoption curve - Source: Jurgen Appelo on Flickr.com-retrieved on June 6,2016

The roadmap for Blockchain prepared by Morgan Stanley, is also supporting this assumption.

The Blockchain technology is on its early stage of invention and experimentation.

In year 2015 many financial institutions, regulatory authorities decided to have a close look at a new and promising technology.

One of the key milestones in **2015** was the announcement of more than 42 banks to join a newly created R3 consortium of banks, in order to test existing Blockchain solutions on the market, and jointly elaborate a tailored-made technology for the industry.

Already in **2016 R3** announced about a new Blockchain technology developed as a tailored made solution for financial sector, **Corda system**.

At the same time banks started the testing phase, looking for the best fitting use case for their business. In April 2016, Santander UK became the first UK bank, which has launched a Blockchain in its organisation, primarily within employees, in order to gather more experience with its functionality and usability.

Morgan Stanley has created a timeline for the further Blockchain adoption till **2025**.

In the first phase between **2016 till 2018** there will be an extensive proof of concept and testing of the use cases will show if this technology can indeed reduce costs for banks and financial institutions and if it is scalable.

As **2018** will be an important year especially in EU zone, when third parties will be getting access to banking customer data through open API's, under the PSD2 regulation. This important milestone will be helping banks to adopt their infrastructure to externalised platforms operating on Blockchain.

During **2017-2020** Morgan Stanley foresees the period, when the shared infrastructure emerging within more banks.

In 2021-2025- more assets are expected to move to Blockchain as efficiencies prove out.^{lxxvii}

I personally, find the above mentioned roadmap feasible and realistic, as there are a lot of happenings in this space with extensive cooperation between regulators, technological companies, banks and digital currency, Blockchain companies.

4.3 Money Laundry and financial crime

Virtual currencies, such as Bitcoin are very interesting for criminal and fraudsters because its anonymous nature. Virtual currencies are not controlled by any regulatory body, all transactions are anonymous and can be executed peer-to peer without leaving any traces behind.

Virtual currencies are used by criminals for money laundering, terrorism financing, trading with drugs, weapons and for human trafficking purposes. One of the criminal platforms Silky Road, founded in 2011 and shut down by the FBI in 2013. It had an operating traffic worth of 1 Million a day. This black marker bazaar was used for illegal drugs were sold for bitcoins. Virtual currencies are driving also new forms of criminal and fraudulent activities. One of such activities is related to a malware, which is installed in your system or on your computer, and it is restricting your access to it. This form is called ransomware, where the owner of the system has to pay ransom to the malware operator in order to remove the restrictions. The one who breaches the system and installs the malware is asking for bitcoins in order to be found.

Taking into account vulnerability of virtual currencies exchanges, the regulators establishing necessary requirements to user authentication and establishing enhanced cybersecurity mechanisms. In trying to regulate virtual currencies the regulators should consider the risks related to them such as:

- **Price volatility of virtual currencies**-they are not issued by any authority, but by private persons or companies. The price is very much dependent on the trust to a special currency within community, expectations of users, negative events, related to certain virtual currency
- **Transparency**-there is no mechanism currently to identify users of the virtual currency wallet
- **No geographical borders for transaction**-as all transactions are done via internet, virtual currencies can be easily transferred between geographies. Virtual currencies can easily dematerialise and can be used for criminal activities.^{lxxviii}
- **Convertibility to fiat currencies**-some of the virtual currencies are also convertible to fiat regulated currencies. With a special animalizing program, it is possible to close the account and open a new one and that way enable user anonymity.

As it is mentioned in the chapter related to regulation of virtual currencies, many regulators are introducing ALM requirements as obligatory requirements to obtain a licence like in the New York State for a BitLicence, or necessary requirements for customer's authentication on virtual currency platforms. In elaborating a common standard for the Blockchain technology, ALM and security are two must have topics to be investigated deeper by banks and other financial institutions.

4.4 Security issues related to the technology

Security is one of the major risks currently associated with the virtual currencies and the Blockchain technology. One of the recent shocking news coming from theft of 50 Million USD dollars of virtual currency ethers from the DAO (Decentralized Autonomous Organisations, based on Blockchain technology) was reminding all distributed ledgers lovers about unsolved problems and risk associated to technology adoption.

The DAO was created as a decentralized investment fund, where each participant had the right to decide in which companies to fund. Your contribution in the organisation was making your vote more significant. The DAO is built on Ethereum, another sort of the distributed ledger. The DAO project is financed by investors, who put more than 150 million dollars of the virtual currency called Ether into this project.^{lxxix} The value of the virtual currency Enter has dropped by **2,7% during 1 day**.

ETHEREUM EXCHANGE

ETH/BTC



Table 5: Ethereum exchange rate - Source: Poloniex.com-retrieved on June 27,2016

It is still not clear, if this hacker attack on DAO was targeting financial funds or was aiming to prove systems vulnerability and change the trust towards this organisation.

These risks, related to devaluation of the virtual currency triggered by negative event, should be considered by users and organisations dealing with it. If association of banks will agree on adoption of the Blockchain technology, they have to reinforce security mechanisms in order to protect their customers. One of the characteristics speaking for distributed ledgers is its relatively secure encryption algorithm, hashing witch is not irreversible, meaning if customer sensitive data is transferred on the ledger it can't be encoded by hackers and translated into a real customer data.

It is not unusual, that trading platforms with virtual currencies, such as Bitcoin are often targeted by hackers. One of the biggest thefts in the history of Bitcoin goes back to 2014, when the biggest trading platform Mt. Gox suffered from hacker attack and investors lost more than 400 Millions of USD forever.^{lxxx}

Another attack on the bitcoin trading platform was made in 2015, when Europe's biggest bitcoin exchange has been hacked. More than 19 000 bitcoins (5 Million USD in value) were stolen from Bitstamp accounts. The company promised to repay in full all missing balances in compromised wallets.

4.5 Smart contracts

The term of smart contracts goes back to mid-90s and was first used by a famous cryptographer Nick Szabo. Smart contracts represent a piece of a code with terms of the contract, like **if-then statements**. **Example of a smart contract is in Appendix (include)**

With a rising popularity of cryptocurrencies and Blockchain, smart contracts became a “celebrity”. Smart contracts are a part of the Blockchain infrastructure and can determine conditions of the value transactions between parties. They can even go beyond financial sector and can be used for example in Internet of things as it was proved with Slockit company. Slockit creates a platform for peer-to-peer property sharing using smart contracts as agreements between lender of an object and customer. It works a digital lock on a bike, car or even home. The one who is renting, receives a digital code for unlocking the property or object of the lender.

There are two perspectives towards the smart contract. First one refers to a smart code and a second one to a smart contract as a binding legal agreement. With a binding legal agreement there are still a lot of discussions ongoing between experts. Whether the smart contracts will be used as legal agrees, depends on the Blockchain technology recognition by commercial, legal and political institutions.

Let’s assume, that someday a smart contract will be used by institutions as a legal agreement with their customers. As these contracts will be written by people, there is a big probability of error and mistake. A question arises, who should be in charge of arbitrage between companies and their customers in case smart contracts are not executed correctly, one of the parties is not fulfilling the conditions?

Nevertheless, because smart contracts are coded on the Blockchain, they are not just a piece of a code, but rather immutable piece of code, which is stored and can’t be manipulated retrospective. Another advantage of them is in its ability to store and transfer amounts of cryptocurrency.^{lxxxi}

It is clear, that further experimentation with the underlying technology and smart contracts in particular will help to understand better the practical application of smart contracts in businesses.

5 Conclusion

After doing a lot of research on Blockchain technology, I still remain an evangelist of the technology and dedicated follower.

After more than a decade of blindness and ignorance, banks seem to show first symptoms of recovery. They are finally recognising a need to change in order to survive in the near future. As they relied on their success stories from the past, and continued to expand their empires with new acquisitions, they lost the sense of reality and understanding customers' needs.

The financial crises hit very painful many international banks, 'which were too big to fail'.

Banks lost not only their funds during this time but compromised their spotless reputations as trustworthy, reliable institutions, grants of the stability on the financial markets.

On top the regulators pushed banks to execute 'ascetic practices' on the financial markets, limiting risk appetite for insecure operations.

When all the focus was on 'bad guys', new players with technology driven solutions entered the financial stage, challenging old values and business models.

As their core business is solving financial problems with technological solutions, they were named Fintech. Fintech became a new word for disruption in financial space. The Fintech start-ups are nibbling existing services and products of banks in a very elegant and smart way. They are well tuned with the new customer behaviour, needs and digital identities.

Banks however, with their robust processes, organisational structures, resistance to change are among laggards in the adoption curve of innovations. In their innovation strategies, banks are focusing too much on technological features and solutions, forgetting about inefficiencies incorporated in processes, corporate culture, and hierarchical structures.

The whole digital transformation of banks is a complete farce, if banks are not changing their structures, culture and values.

Many banks will break their legs, many will survive and compete further.

The truth is, that macro trends have to be followed by banks as they are directly impacting their business. Among key trends to observe are changes in customer behaviour, sharing economy, platformification, increasing number of transactions in virtual currencies, fast adoption and development of decentralized ledgers like Blockchain by businesses and users.

Blockchain technology is promising to change the way of value creation and transfer in banks. It will significantly reduce transaction costs, enable auditable and secure operations

on the distributed network. The technology is addressing many topics, like digital identities, security, smart contract, which are of a big interest for banks.

Blockchain technology is however on its early stage of experimentation, and has a lot of open questions, related to an industry standard, security, regulatory framework and scalability of the technology. It will take years, till this technology is adopted by majority of banking institutions.

Close cooperation between banks and regulators will enable to significantly shorten the adoption curve.

Looking at the justification of the distributed ledger adoption by the bank, for a specific use case -international transactions, I came up with the following conclusions:

- While adopting Blockchain for international transactions, banks have to reconsider also their business model:
 - Profit margins that banks currently make on exchange rates, will erase
 - Profits have to be made with fees on the exchange itself. We've seen a beautiful example by TransferWise on doing so. Using their business model, the implementation of Blockchain could have a payback of 2 years only!
- Not every bank needs Blockchain. Depending on their well-chosen strategy, and careful investigations, it can be justified whether or not to implement a distributed ledger. For instance, for local operating banks it's much more likely that they don't need Blockchain. Since they don't have any cross-border operations, it would make the payback probably too long.
- Blockchain is not a panacea and it is not a magic stick, transforming Dinosaurian-banks into a Phoenix.
- As it was discussed and analysed in the chapter 4 (Results and analysis), there is no common understanding, opinion and aligned regulation of virtual currencies, and the usage of Blockchain technology within different jurisdictions. The responses to this innovation vary between warnings and complete prohibition.

The future of banks depends on their ability to embrace the change, stay open to new ideas, allow experimentation and failure inside of their organisations, focus on customer experience and gather experience with new technologies prior to final adoption.

Bibliography

Books

- Drucker Peter F. (2001): The essential Drucker.
- Drucker Peter F. (1985): Innovation and Entrepreneurship.
- Neely Andy, Hii Jasper (2012): innovation capacity of firms.
- Skinner Chris (2014): Digital Bank.
- Skinner Chris (2016): The value web.
- Christensen Clayton M. (1995): Innovation Dilemma.
- Pavitt Keith (1984): Sectoral patterns of technical change: Towards a taxonomy and a theory
- von Hippel Eric (2006): Democratizing innovation.
- Baines T.S, Lightfoot H.W, Benedettini, O. and Kay J.M. (2009): The servitization of manufacturing: A review of literature and reflection on future challenges.
- Merhdad Baghai, Coley Stephen and White David (1999): The Alchemy of Growth,
- Rogers Everett M. (1995): Diffusion of innovations.

Journals, reports & papers

- Neely A., Hii J. (2012): The Innovative Capacity of Firms, Nang Yan Business Journal,1.1,47p.
- Jansen, Tempelaar, van den Bosch, Volberda (2009): Structural Differentiation and Ambidexterity: The Mediating Role of Integration Mechanisms.
- Account (2016): Bank charges on international payments. An analysis of the UK SME market. Money Movers
- Banque de France (2016): FINANCIAL STABILITY IN THE DIGITAL ERA.
- Capgemini and Royal Bank of Scotland (2015): World Payment report 2015.
- Scheinert Christian (2016): Virtual currencies. Challenges following their introduction. European Parliament
- Committee on Payment and Settlement Systems (2003): A glossary of terms used in payments and settlement systems. Bank of international settlements
- Shrier D., Sharma D., Pentland A. (2016): Blockchain & Financial Services: The Fifth Horizon of Networked Innovation. The Massachusetts Institute of Technology
- De Nederlandsche Bank (2016): 2015 Annual Report.

von Hippel Eric (2005): Democratizing Innovation. The MIT Press

ESMA (2015): Call for evidence. Investment using virtual currency or distributed ledger technology.

Tuff G., Wunker S. (2014): Beacons for Business Model Innovation. Deloitte

HM Treasury (2015): Digital currencies: response to the call for information.

Official Journal of the European Union (2015): Directives ... on payment services in the internal market, 93p.

Champagne P. (2014): The Book of Satoshi: The Collected Writings of Bitcoin Creator Satoshi Nakamoto.

Ripple (2016): The Cost-Cutting Case for Banks.

U.S. Securities and Exchange Commission: Ponzi schemes Using virtual Currencies.

Articles from the Internet

Burkill Nick and Lyons Le Croy Deirdre: Virtual currency: a new challenge for international AML enforcement. <http://antifraudnetwork.com/2015/06/virtual-currency-a-new-challenge-for-international-aml-enforcement/> 2015-retrieved on June 6,2016

Chris Skinner: Blockchain? It's complicated. <http://banknxt.com/55981/blockchain-its-complicated/> 2016-retrieved on June 20,2016

Erin Lace: BitRuble? First Russian Cryptocurrency Announced by Qiwi. <http://cointelegraph.com/news/bitruble-first-russian-cryptocurrency-announced-by-qiwi> 2015-retrieved on June 6,2016

Sandoval Alex: Russian Ministry of Finance Proposes 7 Years in Prison for Cryptocurrency Use. <http://cointelegraph.com/news/russia-proposes-7-years-in-prison-for-cryptocurrency> 2016-retrieved on June 1,2016

Figo GmbH: HOW OPEN APIS WILL CHANGE THE FUTURE OF BANKING. <http://de.slideshare.net/ambajorat/how-open-apis-will-change-the-future-of-banking> 2016-retrieved on May 21,2016

Fintechnews Switzerland: Morgan Stanley Shares Roadmap for Blockchain Adoption. http://fintechnews.ch/blockchain_bitcoin/morgan-stanley-shares-roadmap-blockchain-adoption/4234/ 2016-retrieved on June 22,2016

Russian Central Bank Insists Bitcoin and Blockchain Are Separate.
<http://forklog.net/russian-central-bank-insists-bitcoin-and-blockchain-are-separate/>
2016-retrieved on May 4,2016

Harrison Virginia: Hackers steal \$5 million in attack on European bitcoin exchange.
<http://money.cnn.com/2015/01/06/technology/security/bitcoin-bitstamp-hacked/> 2015

Malmö Christopher: Bitcoin is unsustainable. <http://motherboard.vice.com/read/bitcoin-is-unsustainable> 2015-retrieved on June 6,2016

Gómez Eduardo: The DAO is Under Attack, Millions of Ethers Stolen.
<http://themerke.com/the-dao-under-attack-more-millions-of-ethers-stolen/> 2016-
retrieved on June 25,2016

Münzer Jens: Bitcoins: Aufsichtliche Bewertung und Risiken für Nutzer.
http://www.bafin.de/SharedDocs/Veroeffentlichungen/DE/Fachartikel/2014/fa_bj_1401_bitcoins.html 2013-retrieved on May 10,2016

Lee Justin: Banks around the world deploy biometric authentication technologies.
<http://www.biometricupdate.com/201506/banks-around-the-world-deploy-biometric-authentication-technologies> 2015-retrieved on May 10,2016

Lee Justin: ABI Research predicts biometrics market to shift focus on banking, consumer electronics. <http://www.biometricupdate.com/201604/abi-research-predicts-biometrics-market-to-shift-focus-on-banking-consumer-electronics> 2016-retrieved on April 30,2016

del Castillo Michael: The 'Great Bitcoin Exodus' has totally changed New York's bitcoin ecosystem. <http://www.bizjournals.com/newyork/news/2015/08/12/the-great-bitcoin-exodus-has-totally-changed-new.html> 2015-retrieved on April 21,2016

Hennelly William: Bitcoin trading roaring in China, but the virtual currency faces restrictions. http://www.chinadaily.com.cn/world/2015-03/19/content_19906869.htm
2015-retrieved on April 21,2016

Mubaslat Jad: 5 Bitcoin and Blockchain Start-ups to Watch in 2016.
<http://www.coindesk.com/5-Bitcoin-Blockchain-startups-watch-2016/>2015-retrieved on April 21,2016

Caffyn Grace: Blockchain Platform Setl Exceeds 1 Billion Transaction 'Milestone'.
<http://www.coindesk.com/blockchain-platform-setl-exceeds-1-billion-transaction-milestone/> 2015-retrieved on May 10,2016

CoinDesk: How to Set Up a Bitcoin Miner. <http://www.coindesk.com/information/how-to-set-up-a-miner/> 2013-retrieved on April 21,2016

CoinDesk: What Can You Buy with Bitcoin? <http://www.coindesk.com/information/what-can-you-buy-with-Bitcoins/> 2015-retrieved on April 21,2016

Rizzo Pete: Japan's Largest Bank Latest to Develop Own Digital Currency. <http://www.coindesk.com/japans-bank-tokyo-mitsubishi-mufg-coin/> 2016-retrieved on April 19,2016

Stark Josh: Making Sense of Blockchain Smart Contracts <http://www.coindesk.com/making-sense-smart-contracts/> 2016-retrieved on April 19,201

Prigg Mark: Microsoft sells its maps to Uber: Technology to help app firm develop self-driving car to take on Google. <http://www.dailymail.co.uk/sciencetech/article-3143900/Microsoft-sells-maps-Uber-help-develop-self-driving-car.html> 2015-retrieved on April 19,2016

Diebold: CONTACTLESS TECHNOLOGY. <http://www.diebold.com/irving> --retrieved on March 5,2016

De Nederlandsche Bank: Virtual currencies are not a viable alternative. <http://www.dnb.nl/en/news/news-and-archive/dnbulletin-2014/dnb307263.jsp> 2014-retrieved on May 6,2016

De Nederlandsche Bank: DNB warns banks and payment institutions about integrity risks associated with virtual currencies. <http://www.dnb.nl/en/publications/dnb-publications/newsletters/nieuwsbrief-banken/nieuwsbrief-banken-juni-2014/dnb308035.jsp> 2014-retrieved on May 6,2016

Fast Company: The Most Innovative Companies of 2016. <http://www.fastcompany.com/most-innovative-companies/> - <http://www.fatf-gafi.org/about/>-retrieved on May 6,2016

Wildau Gabriel: Tencent launches China's first online-only bank. <http://www.ft.com/intl/cms/s/0/ccc5a6dc-9488-11e4-82c7-00144feabdc0.html#axzz47R3IWhL0> 2015-retrieved on May 6,2016

Moramarco Steve: 10 Crazy Bitcoin Stories. http://www.oddee.com/item_98810.aspx/RK=0/RS=A1qJfcGR._p8dE3q9h9I5x0YLul%C2%B7 2014-retrieved on May 17,2016

Statista: Average per card transaction amount of leading debit card brands worldwide in 2011 (in U.S. dollars). <http://www.statista.com/statistics/261300/average-per-card-transaction-amount-of-leading-debit-card-brands-worldwide/>-retrieved on May 2,2016

RICK CAREW: China's Tencent-Backed WeBank Raising Funds at \$5.5 Billion Valuation. <http://www.wsj.com/articles/chinas-tencent-backed-webank-raising-funds-at-5-5-billion-valuation-1453892057> 2016-retrieved on June 21,2016

Capaccioli Stefano: Central Bank of Italy Declares Virtual Currency Exchanges Are Not Subject to AML Requirements. <https://bitcoinmagazine.com/articles/central-bank-italy-declares-virtual-currency-exchanges-not-subject-aml-requirements-1423096093> 2015-retrieved on June 21,2016

Bitcoin Wiki: Hashcash. <https://en.Bitcoin.it/wiki/Hashcash>-retrieved on June 21,2016

Bitcoin Wiki: Proof of work. https://en.Bitcoin.it/wiki/Proof_of_work-retrieved on June 21,2016

Wikipedia: Cash machine. https://en.wikipedia.org/wiki/Cash_machine-retrieved on June 21,2016

Wikipedia: Chatbot. <https://en.wikipedia.org/wiki/Chatbot>-retrieved on June 21,2016

Wikipedia: China UnionPay. https://en.wikipedia.org/wiki/China_UnionPay-retrieved on June 21,2016

Wikipedia: Digital currency. https://en.wikipedia.org/wiki/Digital_currency-retrieved on June 21,2016

Wikipedia: List of mergers and acquisitions by Apple

https://en.wikipedia.org/wiki/List_of_mergers_and_acquisitions_by_Apple-retrieved on June 5,2016

Wikipedia: List of mergers and acquisitions by Google.

https://en.wikipedia.org/wiki/List_of_mergers_and_acquisitions_by_Google-retrieved on June 5,2016

Wikipedia: List of mergers and acquisitions by Microsoft.

https://en.wikipedia.org/wiki/List_of_mergers_and_acquisitions_by_Microsoft-retrieved on June 5,2016

Wikipedia: Mobile banking. https://en.wikipedia.org/wiki/Mobile_banking-retrieved on June 21,2016

Wikipedia: Peer to peer lending. https://en.wikipedia.org/wiki/Peer-to-peer_lending-retrieved on June 21,2016

Wikipedia: Robo-advisor. <https://en.wikipedia.org/wiki/Robo-advisor>-retrieved on June 21,2016

Wikipedia: Service innovation. https://en.wikipedia.org/wiki/Service_innovation-retrieved on June 21,2016

Wikipedia: Society for Worldwide Interbank Financial Telecommunication. https://en.wikipedia.org/wiki/Society_for_Worldwide_Interbank_Financial_Telecommunication-retrieved on June 21,2016

Ripple: Technology. <https://ripple.com/technology/>-retrieved on June 17,2016

Venzen Khaosan: What Affects the Bitcoin Price? <https://www.cryptocoinsnews.com/affects-Bitcoin-price/> 2014-retrieved on June 17,2016

Doblin: A FRAMEWORK FOR INNOVATION. <https://www.doblin.com/ten-types>-retrieved on May 7,2016

Europol: -. <https://www.europol.europa.eu/content/page/about-us>-retrieved on May 15,2016

IRS: IRS Virtual Currency Guidance: Virtual Currency Is Treated as Property for U.S. Federal Tax Purposes; General Rules for Property Transactions Apply IR-2014-36, March. 25, 2014. <https://www.irs.gov/uac/newsroom/irs-virtual-currency-guidance> 2014-retrieved on May 15,2016

Bouvier Pascal: Fintech Brexistentialism. <https://www.linkedin.com/pulse/fintech-brexistentialism-pascal-bouvier-cfa?trk=prof-post> 2016: -retrieved on June 25,2016

Swift: -. <https://www.swift.com/about-us>-retrieved on June 25,2016

McDonald Henry: 700 US companies now located in Ireland as direct investment soars. <https://www.theguardian.com/world/2015/mar/05/ireland-attracts-soaring-level-of-us-investment> 2015-retrieved on June 25,2016

Appendix A: Statistics on world banking transactions

Table 1: Banknotes and coin in circulation

	Total value (USD billions) ¹					Value per inhabitant (USD) ¹				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Australia	57.18	60.01	64.77	59.54	57.81	2,591.2	2,680.2	2,843.7	2,570.8	2,459.0
Belgium	nav	nav	nav	nav	nav	nav	nav	nav	nav	nav
Brazil	90.71	86.77	91.72	87.23	83.25	464.0	439.6	460.4	433.9	410.6
Canada	63.53	65.34	69.59	67.92	65.28	1,870.7	1,904.7	2,005.6	1,935.0	1,839.2
China	nav	nav	nav	nav	nav	nav	nav	nav	nav	nav
France	nav	nav	nav	nav	nav	nav	nav	nav	nav	nav
Germany	nav	nav	nav	nav	nav	nav	nav	nav	nav	nav
Hong Kong SAR	30.34	34.75	38.95	43.88	45.57	4,302.1	4,886.3	5,426.8	6,075.5	6,272.9
India	211.67	200.18	215.42	210.08	228.64	178.5	166.5	177.0	170.4	180.5
Italy	nav	nav	nav	nav	nav	nav	nav	nav	nav	nav
Japan	1,068.20	1,143.42	1,059.47	903.08	817.07	8,341.6	8,947.0	8,308.6	7,094.3	6,429.4
Korea	37.93	42.10	50.62	59.94	68.07	767.7	845.7	1,012.4	1,193.5	1,350.0
Mexico	56.12	54.62	64.98	70.19	72.22	519.7	501.9	558.8	596.6	607.0
Netherlands	nav	nav	nav	nav	nav	nav	nav	nav	nav	nav
Russia	190.06	214.40	252.71	254.06	157.28	1,330.5	1,499.7	1,764.7	1,770.3	1,084.9
Saudi Arabia	29.59	37.29	40.75	44.37	48.24	1,073.6	1,314.2	1,395.7	1,479.3	1,567.7
Singapore	19.04	21.13	23.82	25.02	26.05	3,750.5	4,075.6	4,484.6	4,633.7	4,762.3
South Africa	23.58	13.57	18.57	11.35	11.66	461.8	262.8	355.6	214.6	217.5
Sweden	15.59	14.44	14.72	13.23	10.76	1,655.2	1,526.6	1,546.5	1,377.6	1,108.8
Switzerland	57.98	62.33	70.71	77.21	71.29	7,360.8	7,877.8	8,842.8	9,544.1	8,655.4
Turkey	32.33	29.42	34.59	35.66	37.35	438.6	393.8	457.4	465.1	480.8
United Kingdom	85.11	89.46	97.65	102.70	102.57	1,356.1	1,413.5	1,532.8	1,602.0	1,587.9
United States	982.72	1,075.79	1,169.13	1,241.16	1,342.88	3,177.0	3,452.7	3,724.8	3,926.1	4,218.2
Euro area	1,154.10	1,182.14	1,237.83	1,354.86	1,267.29	3,431.2	3,505.6	3,661.8	4,000.6	3,734.9
CPMI excl euro area ²	3,051.68	3,245.02	3,378.20	3,306.61	3,246.00	1,261.2	1,327.4	1,364.7	1,322.1	1,275.0
CPMI incl euro area ²	4,205.78	4,427.16	4,616.03	4,661.47	4,513.29	1,526.0	1,591.4	1,640.7	1,641.5	1,564.3

Table 6: Banknotes and coin in circulation - Source: Bank for International Settlements (BIS) -retrieved on May 5,2016

Table 2: Payment transactions by non-banks: total number of transactions

	Total number of transactions (millions)					Increase in the number of transactions (%)				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Australia	6,590	7,129	7,707	8,396	9,080	8.2	8.2	8.1	8.9	7.9
Belgium	2,386	2,503	2,511	2,702	3,437	4.2	4.9	0.3	7.6	27.2
Brazil	19,343	21,636	23,538	26,050	28,753	3.7	11.9	8.8	10.7	10.4
Canada	9,410	9,816	10,126	10,815	11,531	3.7	4.3	3.2	6.8	6.6
China	6,768	8,432	11,203	15,502	22,902	30.5	24.6	32.9	38.4	47.7
France	17,057	17,538	18,068	18,086	18,958	3.9	2.8	3.0	0.1	4.8
Germany	17,324	17,739	18,211	19,590	17,994	4.5	2.4	2.7	7.6	-8.1
Hong Kong SAR	nav	nav	nav	nav	nav	nav	nav	nav	nav	nav
India	6,601	7,686	8,557	9,736	11,383	20.3	16.4	11.3	13.8	16.9
Italy	4,004	4,160	4,263	4,487	4,793	1.4	3.9	2.5	5.3	6.8
Japan	8,921	9,988	11,241	nav	nav	-2.8	12.0	12.5	nav	nav
Korea	12,082	13,494	15,242	17,027	18,895	13.8	11.7	13.0	11.7	11.0
Mexico	2,319	2,617	2,932	3,229	3,465	9.5	12.8	12.1	10.1	7.3
Netherlands	5,442	5,604	5,783	6,351	6,452	6.9	3.0	3.2	9.8	1.6
Russia	4,832	5,646	7,309	9,779	12,650	29.6	16.9	29.5	33.8	29.4
Saudi Arabia	1,372	1,622	1,776	1,859	2,134	16.5	18.2	9.5	4.7	14.7
Singapore	2,569	3,279	3,421	3,767	3,886	6.3	27.7	4.3	10.1	3.2
South Africa	2,187	2,379	2,768	3,078	3,467	nav	8.8	16.3	11.2	12.6
Sweden	2,980	3,102	3,346	3,604	3,900	8.7	4.1	7.9	7.7	8.2
Switzerland	1,339	1,401	1,638	1,710	1,797	5.6	4.7	16.9	4.4	5.1
Turkey	2,197	2,508	2,898	3,461	3,743	15.0	14.2	15.5	19.4	8.2
United Kingdom	16,546	17,795	18,504	19,722	21,266	4.1	7.6	4.0	6.6	7.8
United States	107,021	113,882	117,588	123,141	128,305	2.9	6.4	3.3	4.7	4.2
CPMI ¹	259,290	279,957	298,630	312,090	338,770	5.4	8.0	6.7	8.6	8.5

Table 7: Payment transactions by non-banks: total number of transactions - Source: Bank for International Settlements (BIS) -retrieved on May 5,2016

Table 3: Use of payment instruments by non-banks: number of transactions per payment instrument (part 1/3)

	Credit transfers					Direct debits				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Australia	1,494.3	1,588.1	1,640.8	1,746.0	1,784.6	682.9	705.9	737.3	807.5	883.1
Belgium	1,005.5	1,026.6	946.8	1,022.8	1,366.4	246.0	264.5	285.6	313.1	529.5
Brazil	7,711.0	8,443.5	9,012.7	9,588.2	10,749.1	3,584.0	4,134.8	4,357.9	5,083.3	5,686.1
Canada	997.6	1,043.7	1,136.0	1,225.3	1,262.4	651.1	673.8	699.3	728.4	762.3
China	1,022.0	1,172.6	1,410.0	1,837.2	2,569.0	nav	nav	nav	nav	nav
France	2,989.7	2,977.5	3,097.2	3,250.2	3,416.9	3,411.2	3,533.3	3,543.4	3,107.7	3,541.5
Germany	5,871.7	6,072.5	6,151.0	6,217.4	5,923.6	8,687.3	8,648.3	8,809.5	9,676.4	8,666.9
Hong Kong SAR	nav	nav	nav	nav	nav	nav	nav	nav	nav	nav
India	299.4	403.2	586.0	910.0	1,135.7	156.7	164.7	176.5	192.9	226.0
Italy	1,227.2	1,261.7	1,261.3	1,261.1	1,347.2	593.2	600.7	602.3	624.3	608.1
Japan	1,418.1	1,438.4	1,499.8	1,522.2	1,558.4	nav	nav	nav	nav	nav
Korea	2,655.5	2,909.8	3,165.2	3,434.8	3,696.3	1,420.0	1,492.6	1,653.0	1,702.2	1,700.0
Mexico	836.2	933.4	991.2	1,057.5	1,090.4	45.9	52.2	58.9	63.8	70.8
Netherlands	1,647.9	1,647.9	1,623.7	2,013.7	2,043.2	1,310.2	1,340.4	1,368.6	1,329.7	1,163.4
Russia	2,630.0	2,683.6	2,689.2	2,833.4	2,840.5	136.7	118.0	82.1	84.8	84.6
Saudi Arabia	4.0	4.8	5.9	7.2	8.4	1.5	1.2	1.2	1.4	1.6
Singapore	34.6	37.6	39.9	42.7	40.6	57.3	55.0	56.4	57.1	57.2
South Africa	528.7	567.2	653.3	664.6	697.2	563.2	628.0	707.2	766.1	791.3
Sweden	768.0	831.0	859.0	894.0	957.0	272.0	289.0	297.0	312.0	323.0
Switzerland	736.3	753.1	928.0	950.3	961.3	45.2	46.0	55.4	56.8	57.7
Turkey	nav	nav	14.9	229.5	266.6	nav	nav	nav	nav	nav
United Kingdom	3,396.3	3,801.5	3,693.1	3,871.1	3,939.7	3,229.3	3,322.4	3,416.7	3,524.9	3,672.0
United States	7,667.5	8,008.8	8,493.6	9,026.5	9,463.8	11,736.3	12,209.2	12,821.7	13,574.6	14,389.5
CPMI¹	44,941.3	47,406.6	49,898.6	53,605.6	57,118.2	36,830.0	38,280.0	39,730.0	42,007.0	43,214.5

Table 8: Use of payment instruments by non-banks: number of transactions per payment instrument - Source: Bank for International Settlements (BIS) -retrieved on May 5,2016

Table 4: Use of payment instruments by non-banks: number of transactions per payment instrument (part 2/3)

	Cheques					E-money payment transactions				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Australia	291.1	256.4	224.4	194.4	166.6	nav	nav	nav	nav	nav
Belgium	7.2	6.5	5.4	4.3	2.9	60.6	50.5	46.2	29.4	28.5
Brazil	1,675.0	1,590.2	1,438.5	1,304.1	1,170.7	35.4	37.4	36.0	38.1	27.8
Canada	915.5	870.9	805.5	781.1	708.9	nav	nav	nav	nav	nav
China	896.5	846.7	783.7	693.4	578.2	nav	nav	nav	nav	nav
France	3,122.8	2,971.4	2,805.6	2,620.6	2,482.8	41.1	46.5	52.2	50.5	52.9
Germany	48.3	40.6	34.4	31.3	29.7	38.9	35.9	33.6	31.8	38.4
Hong Kong SAR	nav	nav	nav	nav	nav	nav	nav	nav	nav	nav
India	1,387.4	1,341.9	1,313.7	1,257.3	1,195.8	9.7	30.6	66.1	133.6	310.7
Italy	315.1	291.6	275.7	252.4	231.5	118.3	151.9	191.2	244.0	291.4
Japan	88.0	82.6	77.5	73.1	68.9	2,000.4	2,342.0	2,836.6	3,453.4	4,235.4
Korea	752.0	612.9	460.1	364.3	310.3	159.1	113.1	69.7	48.0	38.3
Mexico	428.0	398.3	377.5	348.3	330.5	nav	nav	nav	nav	nav
Netherlands	nav	nav	nav	nav	nav	178.3	171.7	148.0	121.2	76.2
Russia	0.0	0.0	0.0	0.0	0.0	79.1	106.2	225.7	564.4	1,013.6
Saudi Arabia	7.1	7.1	7.1	7.1	6.8	nav	nav	nav	nav	nav
Singapore	78.3	78.8	74.6	72.2	69.4	2,195.4	2,888.2	3,015.1	3,085.3	3,138.1
South Africa	77.1	53.7	42.2	30.9	22.9	nav	nav	nav	nav	nav
Sweden	0.4	0.4	0.2	0.1	0.0	nav	nav	nav	nav	nav
Switzerland	0.4	0.3	0.3	0.2	nav	15.3	10.6	2.8	1.4	nav
Turkey	18.7	18.2	18.5	17.2	17.4	nav	nav	nav	nav	nav
United Kingdom	1,113.0	970.0	848.0	718.0	644.0	nav	nav	nav	nav	nav
United States	22,389.2	20,378.0	18,334.5	16,319.7	14,338.9	nav	nav	nav	nav	nav
CPMI¹	33,611.0	30,814.4	27,927.2	25,070.0	22,376.2	4,931.5	5,984.7	6,723.3	7,801.0	9,251.3

Please refer to the individual country tables for a detailed explanation.

¹ Sum or average excluding those countries for which data are not available. For credit transfers, data for France (prior to 2005) and the United Kingdom include interbank transactions; however, the total number is relatively small.

Table 9: Use of payment instruments by non-banks: number of transactions per payment instrument - Source: Bank for International Settlements (BIS) -retrieved on May 5,2016

Table 5: Use of payment instruments by non-banks: number of transactions per payment instrument (part 3/3)

	Card payments (except e-money)					of which: by cards with a debit function				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Australia	3,832.4	4,269.2	4,773.7	5,301.2	5,862.9	2,259.4	2,606.7	2,998.1	3,384.5	3,790.6
Belgium	1,066.9	1,154.3	1,228.9	1,332.3	1,508.2	945.9	1,020.6	1,087.6	1,168.6	1,349.5
Brazil	6,337.2	7,430.0	8,693.1	10,036.1	11,119.4	2,949.3	3,509.3	4,130.4	4,910.3	5,628.2
Canada	6,846.1	7,227.2	7,484.8	8,099.2	8,796.8	3,971.0	4,143.0	4,357.3	4,518.9	4,899.0
China	4,849.4	6,413.0	9,009.1	12,971.0	19,754.4	nav	nav	nav	nav	nav
France ¹	7,391.6	7,911.0	8,475.0	8,964.3	9,437.9	nav	nav	nav	nav	4,924.2
Germany	2,678.1	2,941.4	3,182.2	3,632.8	3,335.4	2,196.3	2,399.7	2,579.1	2,885.3	2,574.9
Hong Kong SAR	nav	nav	nav	nav	nav	105.4	109.7	112.2	114.1	118.3
India	4,747.7	5,745.4	6,414.3	7,241.6	8,514.3	4,470.5	5,409.5	5,999.2	6,711.9	7,872.5
Italy	1,502.4	1,566.9	1,629.0	1,813.2	2,034.0	914.8	981.1	1,091.5	1,225.8	1,390.1
Japan	5,414.5	6,124.8	6,826.7	nav	nav	13.4	13.4	12.9	12.4	11.4
Korea	7,095.1	8,365.0	9,893.6	11,477.7	13,150.2	1,419.1	1,909.7	2,545.3	3,443.4	4,401.6
Mexico	1,009.1	1,232.8	1,504.8	1,759.6	1,973.4	598.6	741.8	919.2	1,116.0	1,296.6
Netherlands	2,305.6	2,444.4	2,642.9	2,886.2	3,168.7	2,206.4	2,333.9	2,530.7	2,765.0	3,037.5
Russia	1,014.3	1,662.1	2,853.9	4,584.5	6,815.6	959.6	1,556.9	2,631.2	4,150.1	6,101.0
Saudi Arabia	1,260.8	1,485.5	1,624.3	1,696.7	1,962.3	1,226.1	1,445.1	1,570.9	1,629.6	1,894.1
Singapore	203.1	221.7	235.3	509.3	581.0	203.1	221.7	235.3	258.2	293.9
South Africa	1,017.9	1,130.6	1,365.5	1,616.0	1,955.3	nav	nav	nav	nav	nav
Sweden	1,940.0	1,982.0	2,190.0	2,398.0	2,619.9	1,558.0	1,629.0	1,810.0	1,986.8	2,169.5
Switzerland	541.7	591.2	651.3	701.1	778.5	373.7	400.9	435.6	460.9	508.8
Turkey	2,178.1	2,490.0	2,864.6	3,214.2	3,459.1	220.2	308.4	437.4	574.1	719.7
United Kingdom	8,807.0	9,901.0	10,546.0	11,608.0	13,010.0	6,604.0	7,612.0	8,155.0	9,040.0	10,227.0
United States	65,228.0	73,285.9	77,938.6	84,220.5	90,113.0	43,780.4	49,006.1	51,717.2	56,020.8	59,539.3
CPMI²	137,266.9	155,575.5	172,025.4	186,063.7	209,950.4	76,975.0	87,358.4	95,356.1	106,376.6	122,747.7

Table 10: Use of payment instruments by non-banks: number of transactions per payment instrument - Source: Bank for International Settlements (BIS) -retrieved on May 5,2016

Appendix B: Mind map of German FinTech companies



Figure 19: German Fintech Mind map - Source: Paymentandbanking.com-retrieved on June 25,2016

Appendix C: List of companies working on biometric authentication

Company	Profile	Type of biometric authentication
Alibaba. Group Holding Limited	online and mobile commerce	facial recognition
Apple Inc.	music, mobile, computers	fingerprint recognition
Aware Inc.	biometric software	facial, iris, fingerprint recognition
BIO-key	advanced identification solutions	fingerprint recognition
CACI International Inc.	information solutions for security	facial, iris recognition
Diebold Inc.	self-service delivery and security integrated solutions (ATM's)	vein pattern recognition
Fujitsu	information communication technology	vein pattern recognition
Hitachi	information and physical security solutions	vein pattern recognition
Honeywell International Inc.	technology and manufacturing	fingerprint recognition
Intel Corp.	computing innovation	fingerprint, facial recognition
MasterCard Incorporated	global payment technology	fingerprint, facial recognition
Microsoft Corp.	software services, hardware	crypto graphical ID
NEC Corp.	systems, integrated solutions for computing/communication	facial, fingerprint recognition, portable DANN
Nuance Communications, Inc.	voice and language solutions	voice recognition
PayPal	payment solutions	fingerprint recognition
Visa, Inc.	payment solutions	facial recognition
Samsung Electronics Company	consumer electronics	voice, fingerprint recognition
Synaptics Inc..	human interface solutions	fingerprint recognition
3M Company.	safety, security	Fingerprint recognition, iris recognition
Toronto Dominion Bank	banking	voice recognition
Royal Bank of Canada (RBC)	banking	fingerprint recognition
Santander UK	banking	fingerprint recognition (Touch ID)
Bank Zachodni WBK (Santander Group)	banking	vein pattern recognition
Wells Fargo ^{boxii}	banking	hybrid: facial, voice recognition
HDFC bank	banking	fingerprint recognition
RBS bank	banking	fingerprint recognition (Touch ID)
NatWest bank	banking	fingerprint recognition (Touch ID)
HSBS	banking	voice, fingerprint recognition
Barclays	banking	finger, vein pattern recognition
Danske Bank	banking	behaviour recognition

Table 11: Companies working on biometric authentication - Source: Investorideas.com-retrieved on May 5,2016

Appendix D: List of Blockchain companies

- **BitFury**
the best-funded Bitcoin mining company with over 60m raised so far.^{lxxxiii}
- **Zapchain**
social media platform with integrated micropayment in Bitcoin. You can tip with Bitcoins in case you like the content created by other users
- **Open Bazaar**
released in April 2016 a decentralized market space for trading in Bitcoins. It can be a competitor for EBay in the future if adopted among consumers.
- **tØ**
is a Blockchain-based trading platform created by online company Overstock. Its key focus is in trading with securities.
- **Blockstream**
it is a Bitcoin company working on the open assets and smart contracts.
- **Enigma**
is a start-up created in the MIT lab. It is a decentralized cloud platform that ensures privacy. Private data can be stored, shared and analysed without fully revealed to any party. As one of the future possible applications can be sharing of medical information of patients between hospitals, keeping the data anonymous.
- **Slockit**
a German based start-up combining Blockchain technology with internet of things. Slockit promises to revolutionize a shared economy in the future.
- **Provenance**
supply chain solution based on Ethereum technology.

Footnotes

- ⁱ Value Web-is used by Chris Skinner in relationship to a Blockchain ability to transfer value, digital money, between distributed participants of the network.
- ⁱⁱ Fintech -it is a new form of business line, based on using software to provide financial services
- ⁱⁱⁱ Drucker, The essential Drucker, pp.273-279
- ^{iv} https://en.wikipedia.org/wiki/List_of_mergers_and_acquisitions_by_Google
- ^v https://en.wikipedia.org/wiki/List_of_mergers_and_acquisitions_by_Apple
- ^{vi} https://en.wikipedia.org/wiki/List_of_mergers_and_acquisitions_by_Microsoft
- ^{vii} <http://www.dailymail.co.uk/sciencetech/article-3143900/Microsoft-sells-maps-Uber-help-develop-self-driving-car.html>
- ^{viii} https://en.wikipedia.org/wiki/Service_innovation
- ^{ix} https://en.wikipedia.org/wiki/Service_innovation
- ^x <http://web.mit.edu/evhippel/www/democ1.htm>
- ^{xi} <http://www.fastcompany.com/most-innovative-companies/>
- ^{xii} https://en.wikipedia.org/wiki/Cash_machine
- ^{xiii} <http://www.diebold.com/irving>
- ^{xiv} <https://www.swift.com/about-us>
- ^{xv} https://en.wikipedia.org/wiki/Mobile_banking
- ^{xvi} Wireless Application Protocol
- ^{xvii} <http://www.ft.com/intl/cms/s/0/ccc5a6dc-9488-11e4-82c7-00144feabdc0.html#axzz47R3IWhL0>
- ^{xviii} <http://www.wsj.com/articles/chinas-tencent-backed-webank-raising-funds-at-5-5-billion-valuation-1453892057>
- ^{xix} https://en.wikipedia.org/wiki/China_UnionPay
- ^{xx} <http://www.statista.com/statistics/261300/average-per-card-transaction-amount-of-leading-debit-card-brands-worldwide/>
- ^{xxi} <http://www.biometricupdate.com/201604/abi-research-predicts-biometrics-market-to-shift-focus-on-banking-consumer-electronics>
- ^{xxii} <https://en.wikipedia.org/wiki/Robo-advisor>
- ^{xxiii} <https://en.wikipedia.org/wiki/Chatbot>
- ^{xxiv} https://en.wikipedia.org/wiki/Peer-to-peer_lending
- ^{xxv} <http://de.slideshare.net/ambajorat/how-open-apis-will-change-the-future-of-banking>
- ^{xxvi} https://en.wikipedia.org/wiki/Digital_currency
- ^{xxvii} P. Champagne 2014, The book of Satoshi, pp.1
- ^{xxviii} P. Champagne 2014, The book of Satoshi, pp. 10
- ^{xxix} <http://motherboard.vice.com/read/Bitcoin-is-unsustainable>
- ^{xxx} https://en.Bitcoin.it/wiki/Proof_of_work
- ^{xxxi} <https://en.Bitcoin.it/wiki/Hashcash>

-
- xxxii <http://www.coindesk.com/information/how-to-set-up-a-miner/>
- xxxiii <https://www.cryptocoinsnews.com/affects-Bitcoin-price/>
- xxxiv http://www.oddee.com/item_98810.aspx/RK=0/RS=A1qJfcGR_p8dE3q9h9I5x0YLul%C2%B7
- xxxv <http://www.coindesk.com/information/what-can-you-buy-with-Bitcoins/>
- xxxvi <http://www.coindesk.com/japans-bank-tokyo-mitsubishi-mufg-coin/>
- xxxvii MIT, Blockchain & Financial Services: The Fifth Horizon of Networked Innovation, David Shrier, Deven Sharma, Alex Pentland, 2016
- xxxviii <http://banknxt.com/55981/blockchain-its-complicated/>
- xxxix <https://www.doblin.com/ten-types>
- xl https://www.doblin.com/dist/images/uploads/Beacons_Article_vf7_single.pdf
- xli <http://www.coindesk.com/blockchain-platform-setl-exceeds-1-billion-transaction-milestone/>
- xlii http://www.bis.org/cpmi/glossary_030301.pdf
- xliii BIS glossary: payment order an order or message requesting the transfer of funds (in the form of a monetary claim on a party) to the order of the payee. The order may relate either to a credit transfer or to a debit transfer. Also called payment instruction. International payment instruction is related to a cross-border funds transfer.
- xliv Money Mover, Bank charges on international payments, 2016
- xlv https://ripple.com/files/xrp_cost_model_paper.pdf
- xlvi <https://ripple.com/technology/>
- xlvii Bank charges on international payments – An analysis of the UK SME market by Account Payments Specialist and Money Movers.
- xlviii https://www.fr.capgemini-consulting.com/resource-file-access/resource/pdf/world_payments_report_2015_vfinal.pdf
- xlxxlix Implementation costs are related to a minimum marketable product of international payments, other functionalities
- ^l As this information is not available in any media sources and can vary based on the banks infrastructure, complexity of legacy systems integration I have to make some approximation. The figure of **10 Million** is a cost of a big project implementation in the bank, with operational and IT impacts on the organisation. Basically my banking experience helps me to make this approximation for such big projects.
- ^{li} Transaction cost is 10 drops or 0,00001 XRP, if transaction is verified with 4 other institutions on the network The cost will be 10 drops (1+number of other banks verifying)
- ^{lii} Insider information for a middle-sized bank regarding number of international transactions per day and split into groups based on the amounts
- ^{liii} [http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/579110/EPRS_BRI\(2016\)579110_EN.pdf](http://www.europarl.europa.eu/RegData/etudes/BRIE/2016/579110/EPRS_BRI(2016)579110_EN.pdf)
- ^{liv} https://www.esma.europa.eu/sites/default/files/library/2015/11/2015-532_call_for_evidence_on_virtual_currency_investment.pdf
- ^{lv} <http://www.fatf-gafi.org/about/>
- ^{lvi} <https://www.europol.europa.eu/content/page/about-us>
- ^{lvii} <http://www.cnn.com/2016/05/02/>

-
- lviii <file:///C:/Users/Maria%20Semenchenko/Dropbox/Privat/maria%20study%20docs/Master%20Thesis/Literatu re/PSD2%20official%20document.pdf>
- lix http://www.bafin.de/SharedDocs/Veroeffentlichungen/DE/Fachartikel/2014/fa_bj_1401_bitcoins.html
- lx https://www.banque-france.fr/fileadmin/user_upload/banque_de_france/publications/Revue_de_la_stabilite_financiere/RSF20/FSR 20-Full-text.pdf
- lxi <http://www.dnb.nl/en/news/news-and-archive/dnbulletin-2014/dnb307263.jsp>
- lxii <http://www.dnb.nl/en/publications/dnb-publications/newsletters/nieuwsbrief-banken/nieuwsbrief-banken-juni-2014/dnb308035.jsp>
- lxiii http://www.dnb.nl/en/binaries/Jaarverslag_ENG_web_tcm47-339389.pdf
- lxiv <https://bitcoinmagazine.com/articles/central-bank-italy-declares-virtual-currency-exchanges-not-subject-aml-requirements-1423096093>
- lxv http://www.chinadaily.com.cn/world/2015-03/19/content_19906869.htm
- lxvi <http://cointelegraph.com/news/russia-proposes-7-years-in-prison-for-cryptocurrency>
- lxvii <http://forklog.net/russian-central-bank-insists-bitcoin-and-blockchain-are-separate/>
- lxviii <http://cointelegraph.com/news/bitruble-first-russian-cryptocurrency-announced-by-qiji>
- lxix https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/414040/digital_currencies_response_to_call_for_information_final_changes.pdf
- lxx https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/414040/digital_currencies_response_to_call_for_information_final_changes.pdf
- lxxi <https://www.linkedin.com/pulse/fintech-brexistentialism-pascal-bouvier-cfa?trk=prof-post>
- lxxii <https://www.irs.gov/uac/newsroom/irs-virtual-currency-guidance>
- lxxiii https://www.sec.gov/investor/alerts/ia_virtualcurrencies.pdf
- lxxiv <http://www.bizjournals.com/newyork/news/2015/08/12/the-great-bitcoin-exodus-has-totally-changed-new.html>
- lxxv <https://www.theguardian.com/world/2015/mar/05/ireland-attracts-soaring-level-of-us-investment>
- lxxvi https://en.wikipedia.org/wiki/Society_for_Worldwide_Interbank_Financial_Telecommunication
- lxxvii http://fintechnews.ch/blockchain_bitcoin/morgan-stanley-shares-roadmap-blockchain-adoption/4234/
- lxxviii <http://antifraudnetwork.com/2015/06/virtual-currency-a-new-challenge-for-international-aml-enforcement/>
- lxxix <http://themerke.com/the-dao-under-attack-more-millions-of-ethers-stolen/>
- lxxx <http://money.cnn.com/2015/01/06/technology/security/bitcoin-bitstamp-hacked/>
- lxxxi <http://www.coindesk.com/making-sense-smart-contracts/>
- lxxxii <http://www.biometricupdate.com/201506/banks-around-the-world-deploy-biometric-authentication-technologies>
- lxxxiii <http://www.coindesk.com/5-Bitcoin-Blockchain-startups-watch-2016/>