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Sincerely,

Jose Noronha Rodrigues
ELP Editor in Chief

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Abstract

Bitcoin is a technology operating without a central authority. The management of the transaction and the creation of bitcoins constitute an assumption of responsibility collectively by the network. Bitcoin is free and open. Its design is public, nobody has nor controls this type of currency and any individual can purchase it. Thanks to several of its single properties, Bitcoin entails promising uses, which are not presently covered by the systems of classic payments. The digital currency bitcoin primarily relies on a type of technology referred to as blockchain and has several implications for the economy and corporations. Bitcoins are used everywhere in the world and can serve as a tool of decentralization and freedom. There is a significant number of companies and individuals who use Bitcoin, with certain organizations currently accepting it as a method of payment. Although Bitcoin remains a relatively new phenomenon, it has experienced a rapid growth. At the end of August 2017, the value of all the bitcoins in circulation exceeded 16.5 million bitcoin with millions of dollars exchanged daily in bitcoins (market cap 77 billion dollar). This paper will provide a brief outline of this subject, along with essential information on Blockchain and bitcoin. After providing a definition of the latter two, we will present their impact on the financial industry, and finally we will evaluate the function of the stock of value on the calculation of the volatility of the bitcoin by reporting it to gold and the EUR/USD parity.

Keywords: Bitcoin, blockchain, crypto currency, volatility, currency, value of stock.

Introduction

The blockchain (chain of blocks) is a technology, which makes it possible to store and transmit information in a transparent way, made safe and without a central body of control. It resembles a great database, which contains the history of all the exchanges conducted between its users since its creation. The blockchain can be used in three different ways: for transfer of credits (currency, titles, actions, etc.), for a better traceability of credits and products and to carry out contracts automatically ("smart contracts"). The great characteristic of the blockchain is its decentralized architecture, i.e. it is not lodged by a single waiter but by part of the users. There is no intermediary so that each user can check the validity of the chain individually. The information contained in the blocks (transactions, documents of title, contracts, etc.) is protected by cryptographic processes, which prevent the users from modifying them a posteriori.[1] "The blockchain is an incorruptible digital ledger of economic transactions that can be programmed to record not just financial transactions but virtually everything of value."[2] The bitcoin was created in 2008 by Satoshi Nakamoto, the nickname that a person was given to remain anonymous to date, and who developed the code of the currency and whose true identity remains a mystery. Bitcoin is virtual money on a computer network peer to peer or decentralized based on the principles of cryptography to validate the transactions. Currently, Bitcoin is regarded as alternative currency, because it does not have a legal tender in any country. It does not have a physical support, and it is useful in the transactions online or with the tradesmen who accept them. The transactions of Bitcoin in the real shops take usually the shape of mobile payments using purse electronic. There exist a hundred crypto-currencies, several standards, but the bitcoin is worth expensive than an ounce of gold, a rise which could continue well (at the 9/8/2017, 1 btc = 4259 $/3538 €)[3]. Certain platforms give the opportunity of converting Bitcoin into dollars, euro or yuan. It is the case of Paymium[4] who

1 Blockchain : definition and application of techno behind the bitcoin, La Rédaction, JDN, http://www.journaldunet.com/economie/finance/1195520-blockchain/

2 Don & Alex Tapscott, authors Blockchain Revolution (2016)

3 https://bitcoin.fr/cours-du-bitcoin/

4 Created in 2011, the Paymium French company is pionnier of the Bitcoin services, with several tens of thousands of European consumers. The platform of bitcoin exchange/Paymium.com Euro, is the first European place on the market offering a service in accordance with the European regulation on the services of payment. Paymium also suggests solutions for the tradesmen and the processors of payments enabling them to accept the payments in bitcoins, while being freed from the exchange rate risks and by reducing the expenses of transaction.

allows exchanging bitcoin against euro. The bitcoin has a course very volatile. This volatility is related on the strong speculation around this currency and the absence of a regulating authority. On August 13th, 2017, the course of the bitcoin exceeded for the first time the 4000 dollars, and its value practically doubled in a few months. Its capitalization has as for it reaches 77 billion dollars in the month of September 2017. In this research one presents an outline of the subject to you, you will know the necessary one to what you need to know about Blockchain and the bitcoin. After the definition of these two last, we will present their impacts on financial industry, and in the last we will evaluate the function of the stock of value on the calculation of volatility. Our methodology of work is based on longitudinal studies of the observation and the evolution of the volatility of the bitcoin compared to gold and parity EUR/USD.

1. The chain of block or the blockchain

1.2. Definition and history

The blockchain is a technology of storage and transmission of information, transparent, made safe, and functioning without central body of control. The blockchain, or chains blocks, is indissociable bitcoin. By extension, a blockchain constitutes a database which contains the history of all the exchanges carried out between its users since his creation. This database is made safe and distributed: it is shared by its various users, without intermediary, which makes it possible each one to check the validity of the chain. There exist public blockchains, open to all, and deprived blockchain, of which the accesses and the use are limited to a certain number of actors. A public blockchain can be comparable with a large public, and his is anonymous and like a book countable how can be not falsified. Like writes it the mathematician Jean-Paul Delahaye, it is necessary to think « a very large book, that everyone can read freely and free, on which everyone can write, but which is impossible to delete and indestructible.»[5] The operation of the blockchain is founded on control by the majority, primarily, it is right an entry of digital operations, shared between multiple recipients. It can be updated only by consensus between majorities of participants in the system. And, once entered, information can never be crushed. Thus, the blockchain of the bitcoin contains an unquestionable and verifiable recording of the least transaction bitcoin ever realized.[6] The headlight application of this technology is that of the crypto-currencies like the east for example the bitcoin, which is however far from

5 https://blockchainfrance.net

6 Translation and adaptation of the following article, written by Mike Gault (fondateur et PDG de Guardtime) : http://recode.net/2015/07/05/forget-bitcoin-what-is-the-blockchain-and-why-should-you-care/.

being the only virtual currency [7]: here are different multiples like ether of the blockchain Ethereum. Beyond its monetary aspect, this technology of decentralized storage of information could have multiple applications, of which:

- Applications known as « Bitcoin 2.0 »[8] ;
- Applications based on the intelligent contracts, allowing to exchange all kinds of goods or services [9] ;
- Means of reducing the costs of payment and the costs of transaction.

The international banks made announcements in 2015 on these subjects. Twenty-five of them for example signed a partnership with a R3 US company for the use of blockchain in the financial markets[10]. Citibank also announced its wish to emit its clean crypto currency, Citicoin [11]. In the same way, in April 2015, the UBS bank opened in London its own research laboratory dedicated under investigation of technology blockchain and with its applications in the financial field[12]. Through this research and these consortia, the banks hope to set up a technology based on the blockchain which will become a reference within the banking field. Indeed, the consortium or the bank which will manage the first to leave a tested technology will be capable to invoice its own service near the other actors of the financial field[13] ;

- Means of improving their predictive systems known as "of oracles", for the insurances in particular [14] ;
- The development of insurances peer-to-peers[15].

1.2. Electronic wallet or bitcoin wallet

[A wallet of Bitcoin is software where Bitcoin are stored. To be technically precise, Bitcoin are not stored anywhere; there is a key deprived

7James Temperton, "Bitcoin might fail drank the blockchain is young stag to stay" [files], November 24th, 2014 (consulted on October 26th, 2015).
8 Dominic Frisby, "The Incredible Technology Behind Bitcoin Is About To Change The World" [files], Insider Business, January 21st, 2015 (consulted on October 26th, 2015)
9 Smart Contracts: The Next Big Blockchain Application "[files], Cornell Tech (on June 6th, 2016)
10 "Nine of world' S biggest banks join to forms blockchain partnership", Reuters, September 15th, 2015 (to read online [archive])
11 John Biggs, "Citibank Is Working One Its Own DIGITAL Currency, Citicoin" [files] (consulted on November 20th, 2015)
12 "UBS works with a universal currency based on technology blockchain - ICTjournal" [files], on www.ictjournal.ch (consulted on June 6th, 2016)
13 "The secret battle of the banks to lay hands on the blockchain" [files], on www.journaldunet.com (consulted on June 9th, 2016)
14 Etherum and Oracles [archive].
15 "Insurance distributed and smart contracts" [files], on Blockchain France (consulted on March 8th, 2016).

for each address of Bitcoin which is recorded in the wallet of Bitcoin of the person who has balance. The wallets of Bitcoin facilitate to send and receive Bitcoin and give the property of the balance of Bitcoin to the user. The wallet of Bitcoin comes under many forms; the office, the mobile, the Web and equipment are the four principal types of wallets breaking up the 'wallet of Bitcoin. A wallet of Bitcoin also indicated under the name of a digital wallet. The establishment of such a wallet is a big step in the course of obtaining Bitcoin. Just as Bitcoin are the digital equivalent of cash, a wallet of Bitcoin is similar in a physical wallet. But instead of storing Bitcoin literally, which is stored is much important information like the sure private key used to reach at addresses of Bitcoin and to carry out transactions. The four principal types of wallet are:

- Wallets of office are installed on a desktop and provides to the user complete control above wallet. The wallets of office make it possible to the user to create an address of Bitcoin to send and receive Bitcoins;
- The mobile wallets overcome the handicap of the wallets of office, because this last are fixed in a place. Once you to download the application on your smartphone, the wallet can carry out the same functions like wallet of office, and helps you to directly pay your mobile of anywhere. Thus a mobile wallet facilitates by carrying out payments in the physical stores using the "contact-with-wages" via NFC[16] sweeping a code of QR [17].
- The wallet of Bitcoin, the Android hive and the wallet of Bitcoin of mycelium are little mobile wallets.
- Wallets of Web, they enable you to employ Bitcoin of anywhere, on any browser or mobile. Coinbase and Blockchain are the popular suppliers of wallet of Web.][18]

16 NFC, or Near Field Communication, is a technology still recent and called to spread on all the wandering devices in the years to come. One can affirm without too many risks to be mistaken that the NFC will be in the long term implemented by default on all our smartphones, connected shelves, audio-video readers, as well as Bluetooth or Wifi for example.

17 QR code is the acronym of Quick Answer Codes or code bar 2D. Whereas the classical code bar allows only one horizontal coding, the QR code is in two dimensions and thus understands more information. The QR code is a tag readable by the mobile phones and shelves. Its use makes it possible to give access to audio or video contents, to take part in a quiz or to even carry out a purchase starting from its mobile phone, Written by B.Bathelot, updated on December 17th, 2015. Glossaries: Mobile marketing.

18 Translation and adaptation of the following article, Bitcoin Wallet, http://www.investopedia.com/terms/b/bitcoin-wallet.asp

2. Bitcoin, electronic system of payment

2.1. Definition and history

The bitcoin is a virtual currency (or crypto-currency) created in 2009 by one or more data-processing programmers using the pseudonym "Satoshi Nakamoto". The bitcoin is exchanged of par with par (particular or company) on Internet against of other monetary currencies (euro, dollar, yen…), in-outside classical banking networks. And it is accepted like means by certain physical tradesmen and online. The bitcoin is deprived of legal framework unlike other monetary currencies:

- The bitcoin does not have a legal tender;
- Its value is not controlled by a central bank (the European Central bank for the euro or American Federal reserve concerning the dollar).

[The trade on Internet depends today almost exclusively on financial institutions which are used as third of confidence to treat the electronic payments. Although this system functions rather well for most transactions, it always bails out weaknesses inherent in its model based on confidence. The completely irreversible transactions are not really possible there, since the financial institutions must manage the mediation of conflicts. The cost of this mediation increases the costs of the transactions, limiting in practice the minimal size of a transaction and preventing the possibility of having small inexpensive transactions. Impossibility of having nonreversible payments for nonreversible services generates a cost even more important. With the possibility of reversing the transactions, the need for confidence increases. The merchants must be wary of their customers, by badgering them to obtain more information than necessary. A certain share of frauds is accepted like inevitable. All these costs and uncertainties of payment can be avoided by the use of a physical currency, but no mechanism exists to carry out payments through a communication system without resorting to a third of confidence.][19] On March 2017, the bitcoin exceeded the rate of gold. This is the proof that the virtual currency gains of credibility compared to a yellow metal sounding and stumbling. A bitcoin reached its higher history on May 24th with 2791 dollars in May, while the course of the ounce of gold was established with 1262 dollars. At the end of the month of August 2017, the value of all bitcoins[20] in circulation exceeded 16.5 million bitcoin with million dollars exchanged daily in bitcoins, its market capitalization reached 77 billion dollar). In month of September 2017 the value of the bitcoin was established with the turn of 4259 dollars against 3538 euros.

19 Bitcoin: System of Plastic money in Par-with-Par. Satoshi Nakamoto – satoshin@gmx.com – www.bitcoin.org (Translators: Benkebab, Grondilu, Mackila)
20 https://blockchain.info/fr/charts/total-bitcoins

2.2. Bitcoin and store of value money function

[The functions of the money are generally distinguished and allowed. There is only difference of how much functions the money are distinguished. Jevons in its book starting from 1875 "money and the mechanism of the exchange" defines four basic money functions: Monetary agent, united action of value, level of value and stock of value. In the current money theory other money functions occur like the function of information, the function of investment, etc (Jedlinský 2014, P. 49-51). Need to identify the stock of the money function of express Jevons value with the following argument: "But sometimes a person must condense her property in the smallest compass, so that it can pile up it far during a certain time, or relates it with him to a long journey, or communicate it to a friend in a distant country. "(Jevons, 2011, P. 22) obviously we have improve the possibilities how to communicate the property with a friend in a distant country and the use of Bitcoin is one of them. But the need for storing the property is part leaves essential economy. People must cope with the fact that their incomes change in time and pile up a certain amount of money in good periods during futures bad moments possible. To buy goods which are more expensive than the regular wages the function of the storage of value implies. A contrary argument against the stock of value is made for example by Graham (Graham, 1940) which recognizes only two primary functions of money: money like unit of accounting and money like carrier of the options. All other functions are derived from these primary functions. Graham declared that "many of other things, easy to store, easy to move, provide a substitute more than acceptable for the money in this respect." (Graham, 1940, P. 2) it does not mean that Graham countermanded the stock of function of value of the whole, the need to hold the money remains, but is explained as participation provisional and included under the carrier of the function of option][21].

The defenders of Bitcoin criticize fiduciary currencies for their character of inflation. According to the opinion of the defenders of Bitcoin, the store of the function of value is not achieved by fiduciary currencies and in this function the virtual currencies are competing. There is also the argument that the whole success of the virtual currencies is based on the fact of its not-inflation.[22]

21 Translation and adaptation of the following article, Virtual currency bitcoin in the scope of money definition and blind of been worth, Max Kubát, University of Economics, Winston Churchill sq. 4, Prague 130 67, Czech Republic, pages 413.

22 Translation and adaptation of the following article, Virtual currency bitcoin in the scope of money definition and blind of been worth, Max Kubát, University of Economics, Winston Churchill sq. 4, Prague 130 67, Czech Republic, pages 414.

3. Impact and limit of blockchain technology

The blockchain is a great public countable work (database) where the exchanges are protected and diffused near the community in order to be validated out of economic system. The idea of chain of blocks or Blockchain is a technique of cryptography and a tool of indexation of the "Proof of Work" or POW)[23] who of its own person is based on the tool of Hash cash provides by Adam Back in 1997… 20 years ago. In short and according to us, it is not the technique blockchain in itself which is innovating, but makes of them the evolutions with use, the principles of equipment and services carried by new actors and more precisely in the banking environments and of the insurances.

3.1. Impact blockchain on financial industry

The current financial system is based on the idea of confidence. The banks treat into same time, most of the time via a room of regulation and compensation which has like objective to make reduce the dangers from counterpart by guaranteeing the regulation-delivery of the transactions. According to the opinion of the financial institution, as an organization, some monitoring system, of execution and reconciliation authorize to be on that good progress of the events. One frequently speaks about work of back-office which is usually perceived like centers price for the financial institution. [The collaborative economy functions through a decentralized mode of production (generally via a platform), without intermediary or hierarchical supervision. One understands thus that the blockchain is adapted perfectly to this model. Indeed, the decentralization is in the middle of technology blockchain. Thus, it would seem that the blockchain offer all the tools which the collaborative economy needs: software open-source, data protection, secure management of rights and licenses, etc It is about empower to the maximum the individuals through the computer tools, in order to make them able to carry out transactions without the assistance of a central institution. The principle even of the blockchain is to replace the "thirds of confidence" by distributed computer software, thus the scopes of application are almost unlimited: transport, health, entertainment, and well of others. The blockchain, explains Benjamin Tincq, co-founder of OuiShare[24], « it falls under a major change of our companies which seek to transform our organizational systems (…) and to break with pyramidal logics and the very centralization of the value». One finds in the blockchain logic of collaboration since the users take part jointly

23 http://www.hashcash.org/papers/announce.txt

24 OuiShare is an ONG founded in January 2012 in Paris, which is presented in the form of "a community, an accelerator of ideas and projects dedicated to the emergence of the collaborative company: a society based on principles of opening, collaboration, confidence and division of the value". Source: Wikipedia

in the development of the system and the system remunerates them for their work. Thus the blockchain seems to satisfy the concepts of reciprocity, community and participative financing, expensive with the collaborative economy.][25] The blockchain guaranteed of the substantial economies for the company's financial from a point of view of price-cutting associated with the infrastructure for management with the world money sending, the negotiation of titles and the insurance of conformity with the regulations. That is recovered in the recent analysis of the Santander financial institution[26] who estimates economies with the neighborhoods from 15 to 20 billion each year by 2022. Swiss banking institution UBS [27] estimate for their part that the programs of the blockchain would make it possible to lower the times of the world money sending. In the insurance, the actors, usually attentive against the disruptive techniques, also look in the blockchain of opportunities to increase the combat controls the cheating by a faster and more transparent access to information in more automated way. The management of the layouts of expert testimony is improved by the fact that the same sale once carried out is shared and published on the totality of the infrastructure, which does not authorize any change or defrauds.

3.2. Challenges and limits of Blockchain technology

[The technology of blockchain is surely an innovating technology which has various scopes of application. In spite as of potential occasions, one notes that the technology of blockchain is not a universal solution which will solve all the related questions of corruption that we cope. Without considering the questions of government and intimacy of data, its application about the chain of supplies can lead to a twisted structure of the market and cause a new type of corruption][28]. [Even with these innovating characteristics, the technique blockchain does not go without raising certain notable difficulties. Latency of treatment: the blockchain is based on the infrastructure of nodes to approve the exchanges, an operation which takes eight minutes overall. In such a current situation, the heaviness of these controls slows down the approval of this technique, in spite of its modern character. A lawful lack of framing: the even tool with par given appears not to leave any place to a

25 Oriane TROUGH, Aude CLERK, Meyssane FAKIRL' collaborative economy: first steps of a major recasting of the economic systems towards a total desintermediation by the blockchain? Project of end of studies EMLYON December 2016, pages 46

26http://santanderinnoventures.com/wp-content/uploads/2015/06/The-Fintech-2-0-Paper.pdf

27 https://www.ubs.com/global/en/about_ubs/follow_ubs/highlights/davos-2016.html

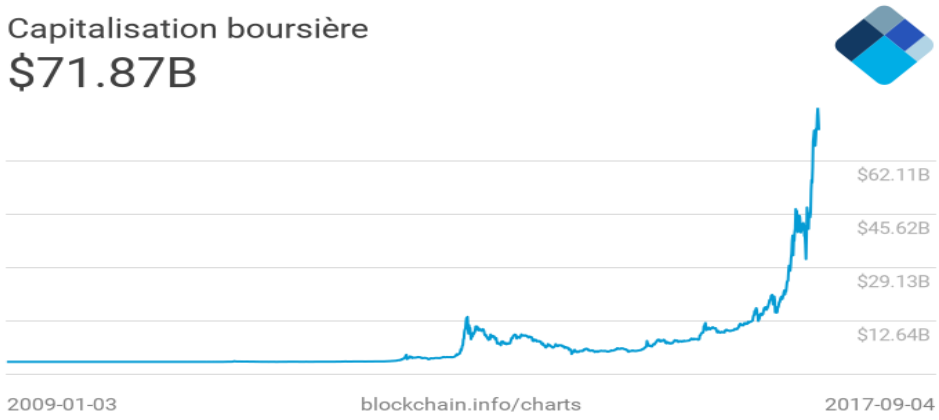
28 Kibum Kim, Consultant at KPMG, Seoul, Korea, Taewon Kang, Ph.D Candidate at Seoul National University, Seoul, Korea Does Technology Against Corruption Always Lead to Benefit? The Potential Risks and Challenges of the Blockchain Technology, 2017, pages 12 et 15

supervisory body. The law and the laws are with collects, leaving open the interrogation of an operation without legal framework. Deficit of qualities methods: in very undertaken, a novel method can sow the imbroglio in the spirit of the people who are in stage of training. Incompatibility with the computer systems which exist: this technology claims deep modifications in the systems which exist and of the placements raised at the moment of the transition. Control, security and confidentiality: even if the blockchain calls on cryptographic methods progress, the pooling of the accounts books of the exchanges can however develop indiscretions of explanations and threaten the confidentiality.][29] The blockchain affects all the lawful while agreeing by anonymous people or organizations and decentralized market. This recent innovation is likely to involve, with final, of the material changes on the strategy of the sovereignty of the State.

4. Statistical data analyses of Bitcoin through the blockchain

4.1. Market capitalization and trade volumes in USD

Figure 1: Market capitalization of Bitcoin

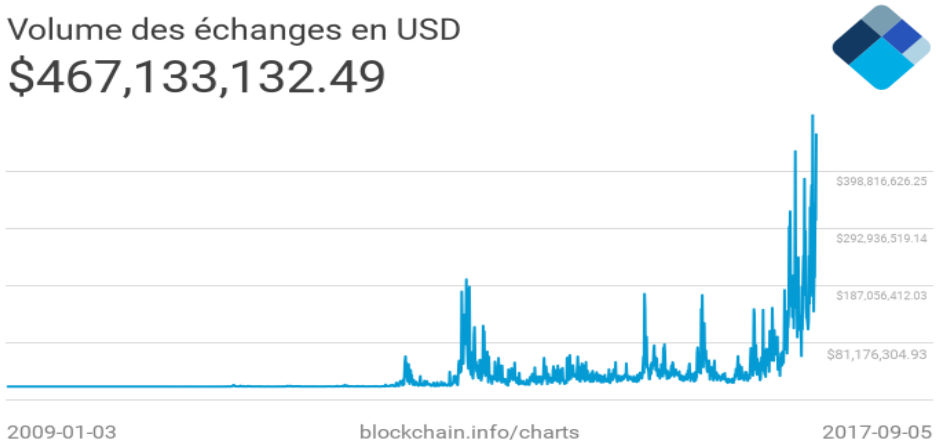


***Source: https://blockchain.info/charts**

The market capitalization of the bitcoin knew one year very animated, in January 2017 it was approximately 16 billion dollar, after eight month and four days it could reach 71.87 billion dollars, that is to say an increase of 55.87 billion dollar.

29 The blockchain: opportunities, advantages and limits July 2017 by Serge Niango, Directing Before-Sale France, Citrix, www.globalsecuritymag.fr/La-blockchain-opportunites,20170710,72521.html

Figure 2: Volumes of exchanges in USD

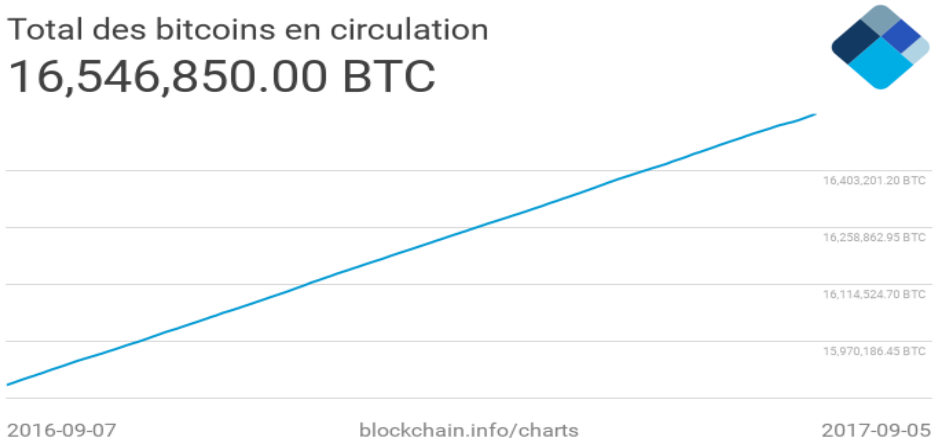


***Source: https://blockchain.info/charts**

Volumes of exchanges in USD at the beginning of the year was approximately 33.9 million dollars, the 9/5/2017 this last knew a very important reversal, the total volume of the transactions reached 467.1 million dollars is an increase of 433.2 million dollars.

4.2. Bitcoin in circulation and Market prices in USD

Figure 3: Bitcoin in circulation



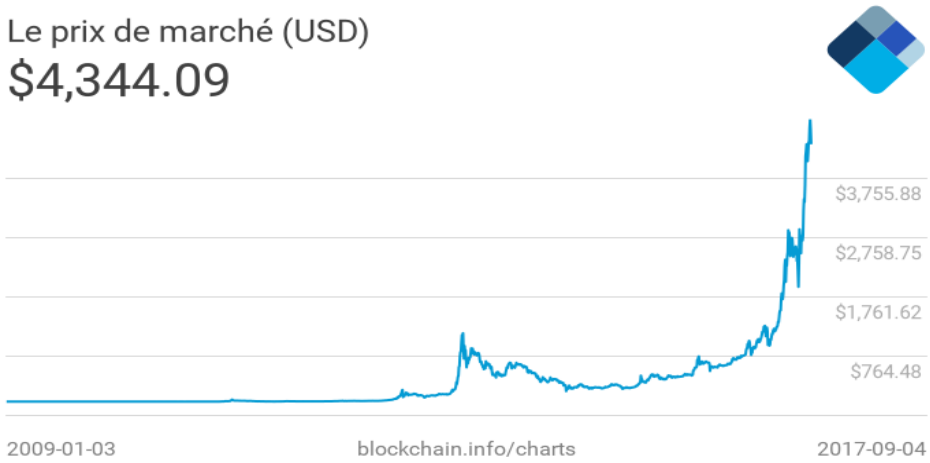
***Source: https://blockchain.info/charts**

Figure 4: Evolution number of Bitcoin in circulation (2009-2017)

Date	Number of Bitcoin
3/01/2009	50
2/01/2010	1 635 850
5/01/2011	5 059 050
4/01/2012	8 030 900
4/01/2013	10 628 700
1/01/2014	12 203 800
2/01/2015	13 678 725
1/01/2016	15 031 975
5/09/2017	16 546 850

***Source: The figures come from the site blockchain.info/charts.**

Figure 5 Market prices in USD



***Source: https://blockchain.info/charts**

From a course of 20 USD recorded in January 2013, Bitcoin was registered quickly and continuously upwards, until reaching 266 USD on April 10th, 2013, in 2014 the price of the BTC passed to 312.71 USD, in 2015 its value reached 431.26 USD. In 2016 a unit BTC was equal to 969.53, thus spending the 9/4/2017 with 4344.09 USD. The forecasts concerning the evolution of the course of the bitcoin remain to complicate, as long as its market is very volatile. For certain analysts the course of the BTC could reach 5000 dollars before the end of the end of the year 2017. This volatility is related to factors of the economic situation such that certain currencies break down it, and the risks of geopolitical tensions all around the world.

5. Empirical study of Historical Volatility BTC, OR and EUR-USD

5.1. Methodology

The bitcoin is not employed in a certain country where the citizens could mainly gain to save bitcoin and finally to buy goods. In this research we will evaluate the function of the stock of value on the calculation of volatility. Volatility can express the probability which it value of a unit of bitcoin or some capital remains stable in the course of time.

Volatility is volatility historical calculated according to the following formula:

The variance VAR is calculated in the following way: $VAR= \frac{1}{n-1} * \sum_{i-1}^{n} (Ri-m)^2$

Volatility VOL is calculated starting from the variance: **VOL** = $\sqrt{var}$

The base of calculation of volatility is calculated is spread out over four years and precisely since 2014. This period of time is justified as period of time when Bitcoin became more known by the public. In this study we go compared the results calculated with the volatility of gold. On March 2nd, 2017, the value of Bitcoin, for the first time, exceeded that of one ounce gold[30] (1BTC = 1257, 6 / XAU=1235, 02)[31] who is often regarded as capital representing the ideal money for everyone which does not like the fiduciary currency and the value of the intrinsic money does not underline. Fiduciary currencies should be also included with the comparison as a true competitor of the virtual currencies. I decided to choose parity EUR-USD. The euro is selected as important currency of the world which had much the problem these last years. The prices (exchange rate) are express in USD. Our methodology of research rests on longitudinal studies based on the observation of the trend of the price bitcoin, that of the gold and the parity EUR-USD.

5.2. Result

Figure 6: Table Historical Volatility BTC, GOLD and EUR-USD

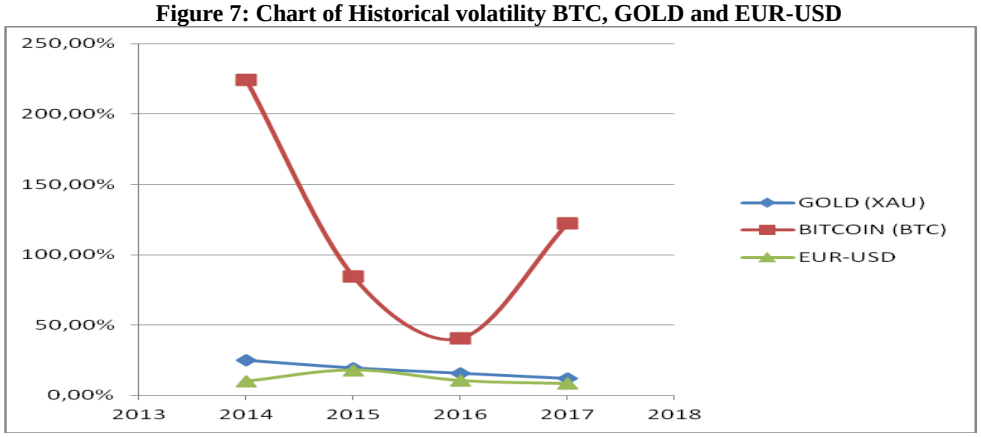
	2014	2015	2016	2017
GOLD (XAU)	24,76%	19,46%	15,74%	12,09%
BITCOIN (BTC)	224,20%	84,67%	40,70%	122,22%
EUR-USD	10,00%	17,98%	10,41%	8,24%

***Source: work out by our own care**

30 Comparison and followed by the trend of the price of the BITCOIN compared to that of gold while basing itself on the daily courses of the period 2009-2017.

31 www.abcbourse.com

Figure 7: Chart of Historical volatility BTC, GOLD and EUR-USD



***Source: work out by our own care**

Interpretation and discussion:

Lowest volatility is reached by parity EUR-USD. The average is of 11.66% in the four years end, and in 2017 it fell from approximately 2.17% compared to the previous year (VOL 2016 =10,41%) the currency shows the lowest volatility of the sample. Perhaps it is little of not very astonishing that the volatility of the currencies is lower than the volatility of gold XAU[32], generally considered as sure capital. However, the gold volatility is very close to the volatility of currencies. In addition the volatility of the bitcoins is appreciably higher implying than the property of catch in this system is riskier.

The volatility of the BTC in 2014 was of 224.20%, the year 2015 was difficult for the users of Bitcoin because of his regression about -74.67%. Similar for the year the 2016 volatility of the bitcoin relapsed of approximately -43.97%. These two years successive Crash can also have more classical explanations. It is possible that an actor holding a great quantity of Bitcoin wished to handle the course by selling a share of his wallet to cause the fall of the course, and to repurchase at better price. It can also to act of escape of a certain number of speculators, which massively resells their Bitcoins, which could be the sign of disillusion, after the euphoria: it was a time when Bitcoin was exchanged for a small thousand of euro.[33] On the other hand the year 2017 was very promising for the bitcoin, its volatility increased (approximately 81.52% to 122.22%) in one eight month period and some day. The exchange rate of Bitcoin, digital currency created in 2009, is shown especially dynamic at this beginning of year (2017). Why bitcoin is such a phenomenon of Russian mountain? The monetary economic recession in India

32 XAU is a code, which means: the code for the quotation of one ounce gold on the financial markets, according to the standard ISO 4217

33 Numerama magazine, Fall of Bitcoin: possible explanations, Julien Lausson 1/14/2015 http://www.numerama.com/magazine/31867-chute-bitcoin.html Business

and the strategy of exchange control in China make bitcoin a species of specific currency refuge, without forgetting that 90% of the transactions on the sector of Bitcoin come from China.[34] Even, if the bitcoin is very volatile, there remains regarded as a currency which meets a growing success. Can we consider the bitcoin as a good currency? Which is the impact of the bitcoin on the economy? Could the bitcoin become currency? The 5/25/2017, one btc is equal to 2450.29 $/2083.74 €, today 1 btc is worth 4631 $/3836 € an increase of 47.09% for the Dollars and a rise of 45.68% compared to the Euro.

Conclusion

The bitcoin became popular; it is paramount to start to have doubts about its use in illegal transactions, because of anonymity which it gives to its users. The criminal activities connected to the bitcoin exist, but they are rare. It is not the perfect currency of the crime because it is easily track, when the amount of the transactions exceeds the standard. It is necessary to also note that the companies which offer platforms of exchange must, like any platform of exchange of currency Forex[35], must know their customers and thus carry out the procedures of KYC[36] . It is possible that the bitcoin is used as means of tax avoidance, today, the fact of buying bitcoins, that can be as to buy gold ingots which one would store without having them to declare with the tax department, draws that the virtual currency does not pose any problem of storage and makes it possible to remain no identifiable thanks to anonymity. Because of their particular (extraterritoriality and absence of organization of regulation) and of their operating process, the currencies digital present risks, which gives the possibility of financing criminal activities and to facilitate the bleaching of the latter. The appearance of new activities in link with the currencies digital asks the question of adaptation, and evolution of the legislative framework and lawful, particularly in terms of fight against the bleaching and the financing of terrorism, and the risks of use illicit ends of the currencies digital. For many analysts, the future of the bitcoin is far from being limited, in particular because its success is very correlated with the world events (like political uncertainties in the United States, the weakness of the growth in China or the elevated level of the debt in the countries of the

34 ZDNet.fr > News > Bitcoin: reasons of a very volatile course By Guillaume Serries 1/6/2017

35 Forex is the abbreviation of FOreign and EXchange which indicates the worldwide market of the currencies, i.e. the market on which exchanges the currencies of the whole world. The FOREX represents in term of total volume, the second financial market of planet behind that of interest rates.

36 Know your customer (KYC) is the name given to the process allowing to check the identity of the customers of a company. The term is also used to refer to the banking regulation which governs these activities.

European Union). In addition, from a legal point of view, an increasing interest goes on the search for a legal definition of the bitcoin in many countries. The interest of a definition and attribution of a legal framework proves a certain confidence and a way of controlling this special currency. The financial world is interested in this financial innovation, by observing its character of diversification and performance. The bitcoin was thus indicated like the most powerful credit of the year 2016 by boursier.com. The Blockchain technique is an information system which gives the possibility of recording exchanges which are filed there in a permanent way. This public channel is accessible to people, and the integrity of information. The totality of the members of the infrastructure has the whole of information. The blockchain is upgrade by the members, which at any moment gives the possibility of having an effective warning, when a new sale is emitted on a public blockchain. It is subordinated to a stage of validation called the "mining", carried out by a "minor". The objectives of the blockchain are innumerable and depend on the use of this one. The fundamental goal is to do without the intermediary. This is especially true for the economic market, where one can ultimately do without the financial institution to approve a financial sale.

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Nudging in The Digital Big Data Era

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Abstract

In the current Behavioral Economics entrance into public policy science, completely undescribed remains that the implicit hidden persuasion opens a gate to deception and is an unprecedented social class division means. Today's social media revolution opens gates to a class dividing nudgital society, in which the provider of social communication tools can reap surplus value from the information shared of social media users. The social media provider thereby becomes a capitalist-industrialist, who benefits from the information shared by social media users as the consumer-worker share private information in their wish to interact with friends and communicate to public. The social media capitalist-industrialist reaps surplus value from the social media consumer-workers' information sharing, which stems from nudging social media users. For one, social media space can be sold to marketers who can constantly penetrate the consumer-worker in a subliminal way with advertisements. But also nudging occurs as the big data compiled about the social media consumer-worker can be resold to marketers and technocrats to draw inferences about consumer choices, contemporary market trends or individual personality cues used for governance control, such as, for instance, border protection and tax compliance purposes. Addressing the nudgital society allows to better understand the laws of motion of governance in the digital age, leading to the potentially unequal accumulation and concentration of power. Technological improvement in the age of information has increased the possibilities to control the innocent social media users and reap the benefits of their existence in hidden persuasion. Nudging can be criticized to be used by the ruling class to exploit the governed populace. In modern democracies, the right to rule was recently proven to be plundered in democratic votes through misguiding information of alternative facts and fake news circulated on social media. The socio-ethical crises that are rooted in the contradictory class division of the nudgital society are presented in this paper

for the first time and from there on demand for further description and research on capitalism and democracy in the digital age.

Keywords: Behavioral Economics, Behavioral Political Economy, Democratisation of information, Education, Exchange value, Governance, Libertarian Paternalism, Nudging, Nudgital, right to delete, right to be forgotten, Social media, Social media capitalist-industrialist, Social media consumer-worker, Social media slavery, Surplus Value, Use value, Winking, Winkital.

Introduction

Since the end of the 1970ies a wide range of psychological, economic and sociological laboratory and field experiments proved human beings deviating from rational choices and standard neo-classical profit maximization axioms to fail to explain how human actually behave (Kahneman & Thaler, 1991). Human beings were shown to use heuristics in the day-to-day decision making as mental short cuts that enable to cope with information overload in a complex world (Kahneman & Tversky, 1979; Thaler & Sunstein, 2008).

From there on, the emerging field of behavioral insights targeted at using human heuristics and biases to improve decision making in different domains ranging from health, wealth and prosperity (Thaler & Sunstein, 2008). Behavioral economists proposed to nudge and wink citizens to make better choices for them with many different applications. Behavioral Insights teams have been formed to advise individual governments around the globe – for instance, Australia, Canada, Colombia, Germany, Italy, the United Kingdom, and the United States (World Development Report, 2015). But also intergovernmental entities such as the European Commission, or global governance institutions, such as the World Bank and the International Monetary Fund, have started using nudges and winks to improve society (World Development Report, 2015).

While the motivation behind nudging appears as a noble endeavor to foster peoples' lives around the world in very many different applications (Marglin, 1974), the nudging approach raises questions of social hierarchy and class division. The motivating force of the nudgital society may open a gate of exploitation of the populace and – based on privacy infringements – stripping them involuntarily from their own decision power in the shadow of legally-permitted libertarian paternalism and under the cloak of the noble goal of welfare-improving global governance. Nudging enables nudgers to plunder the simple uneducated citizen, who is neither aware of the nudging strategies nor able to oversee the tactics used by the nudgers. The nudgers are thereby legally protected by democratically assigned positions they hold or by outsourcing strategies used, in which social media plays a crucial rule.

In the digital age, social media revolutionized human communication around the globe, yet also opened opportunities to unprecedentedly reap benefits from information sharing and big data generation. To this day completely undescribed remains that the implicit hidden persuasion opens a gate to deception and is an unprecedented social class division means. Social media forces are captures as unfolding a class dividing nudgital society, in which the provider of social communication tools can reap surplus value from the information shared of social media users.

The social media provider thereby becomes a capitalist-industrialist, who benefits from the information shared by social media users, or so-called consumer-workers, who share private information in their wish to interact with friends and communicate to public. The social media capitalist-industrialist reaps surplus value from the social media consumer-workers' information sharing, which stems from nudging social media users. For one, social media space can be sold to marketers who can constantly penetrate the consumer-worker in a subliminal way with advertisements. But also nudging occurs as the big data compiled about the social media consumer-worker can be resold to marketers and technocrats to draw inferences about consumer choices, contemporary market trends or individual personality cues used for governance control, such as, for instance, border protection and tax compliance purposes. Unprecedented computational power and storage opportunities have created the possibility to hoard information over time and put it in context with the rest of the population in order to draw inferences about the information sharer (The New York Times, November 14, 2017).[37] The subjective additive utility of information shared tranche by tranche may underestimate the big data holder's advantage to reap benefits from information shared. Problems of the contemporary nudgital society (Puaschunder, 2017) are that big data compilers can reap a surplus value from selling compiled information (The New York Times, November 14, 2017)[38] or manipulate vulnerable population segments based on their previously shared information (The Economist, November 4, 2017).[39]

The law of motion of the nudging societies holds an unequal concentration of power of those who have access to compiled data and who

37 https://www.nytimes.com/2017/11/14/business/dealbook/taxing-companies-for-using-our-personaldata.
html?rref=collection%2Fsectioncollection%2Fbusiness&action=click&contentCollection=business&reg
ion=stream&module=stream_unit&version=latest&contentPlacement=8&pgtype=sectionfront

38 https://www.nytimes.com/2017/11/14/business/dealbook/taxing-companies-for-using-our-personaldata.

39 https://www.economist.com/news/leaders/21730871-facebook-google-and-twitter-were-supposed-savepolitics-

abuse their position under the cloak of hidden persuasion and in the shadow of paternalism. In the nudgital society, information, education and differing social classes determine who the nudgers and who the nudged are. Humans end in different silos or bubbles that differ in who has power and control and who is deceived and being ruled. The owners of the means of governance are able to reap a surplus value in a hidden persuasion, protected by the legal vacuum to curb libertarian paternalism, in the moral shadow of the unnoticeable guidance and under the cloak of the presumption that some know what is more rational than others (Camerer, Issacharoff, Loewenstein, O'Donoghue & Rabin, 2003).

All these features lead to an unprecedented contemporary class struggle between the nudgers (those who nudge) and the nudged (those who are nudged), who are divided by the implicit means of governance in the digital scenery. In this light, governing our common welfare through deceptive means and outsourced governance on social media appears critical. In combination with the underlying assumption of the nudgers knowing better what is right, just and fair within society, the digital age and social media tools hold potential unprecedented ethical challenges.

Outlining the connection of nudging and social class structure is targeted at deriving conclusions about implicit societal impetus of nudging and winking in the 21st century. Alongside of providing an overview of behavioral sciences with an application in the public domain; a critical approach in the economic analysis of contemporary public governance through nudging and winking enabled through social media should be considered. Drawing from some of the historical foundations of political economy will aid to advance the field of behavioral economics through a critical stance on behavioral sciences and new media use for guiding on public concerns in the digital age (Heilbroner, 1988, 1999).

By revealing the contradictions of the social media age of the nudgital society, light is shed on the implicit class struggle rooted in the nudgital social relations of production. Pointing out the limitations of behavioral insights to inform about public choices accurately will be the basis of the critique of a certain ruling class nudging a wide populace by the help of social media. An analysis of the process of the circulation of information leads to conclusions about the metamorphosis of big data and their circuit. By shedding light on the inherent class division in those who nudge (the nudgers) and those who are being nudged (the nudged), the piece proposes further analysis strategies to unravel how the use of behavioral economics for the greater societal good in combination with the rise of social media big data creation may hold unknown socio-ethical downfalls. Taking a heterodox economics stance will aid with interdisciplinary improvement recommendations how to more inclusively alleviate public sector concerns in the digital age. Challenging

contemporary behavioral insights theory is aimed at moving together towards a more inclusive future wiser, more self-informed and protected digital society.

To draw attention to this implicit struggle within society is important for various reasons: Addressing the nudgital society allows to better understand the laws of motion of governance in the digital age, leading to the potentially unequal accumulation and concentration of power. Technological improvement in the age of information has increased the possibilities to control the innocent social media users and reap the benefits of their existence in hidden persuasion.

In the age of populism, nudging can be criticized to be used by the ruling class to exploit the governed populace. In modern democracies, the right to rule was recently plundered in democratic votes through misguiding information of alternative facts and fake news circulated on social media. The socio-ethical crises that are rooted in the contradictory class division of the nudgital society are presented hereby for the first time and from there on demand for further description and research on capitalism and democracy in the digital age. This piece therefore advocates for a democratisation of information, education about nudges and well-informed distribution of transparent governance control.

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Understanding Risk and Uncertainty Management Practice in Complex Projects

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Abstract

The project management literature extensively documents project failures and observes that increases in project complexity have played a role in such failures. Additionally, the literature expresses concern that prescribed industry risk management standards are not sufficiently robust to assist in the management of risk and uncertainty, especially in complex projects. Yet, the management of risk and uncertainty is the cornerstone of the project manager's role. There is limited evidence in the literature of empirical research focused primarily on the management of risk and uncertainty with complex projects. This paper aims to investigate the practices used by project managers to address risk and uncertainty and to critically analyse the success of these methods in complex projects. The findings of this paper is contribute to addressing practical challenges, issues and concerns facing project managers in relation to the management of risk and uncertainty in complex project environments. Risk and uncertainty are vital elements of projects and this paper will act as a guide for the improvement of risk management and uncertainty practices and further contribute to the collection of empirical research relating to this topic.

Keywords: Risk, risk management, uncertainty, complex projects, project complexity.

Introduction

In terms of cost overrun and time delays, project failure is a common outcome and has been the subject of extensive empirical research in project procurement (Bosch-Rekveldt, 2011; Flyvbjerg et al., 2003; Morris & Hough, 1987). The increasing complexity of modern projects necessitates a focus for a better understanding of increasing risk and uncertainty. The complexity in projects is increasing at the project level (Baccarini, 1996; Marle & Vidal, 2016; Nguyen et al., 2015; Williams, 1999; Zhang, 2011) and many recent

project failures can be attributed to underestimating project complexity and the mismanagement of risk and uncertainty (Bosch-Rekveldt et al., 2011). The rate at which projects are likely to fail is proportionate to the rate of increasing complexity, combined with the unsuccessful application of the generally prescribed industry risk standards (Flyvbjerg et al., 2003; Kutsch et al., 2011; Harvett, 2013; Qureshi & Kang, 2015). This raises the question of whether the industry risk management techniques currently in use are capable of successfully handling the complexity, the operating environments and the externalities of modern projects (Bloom, 2014; Smith & Irwin, 2006) and whether they can successfully manage risk and uncertainty in a complex operating environment (Ward & Chapman, 2002, 2003). The correct management of these elements is a fundamental requirement for project success (Davis, 2017).

The primary focus of this paper is an understanding of project failure experienced by project managers in relation to the suboptimal application of generally prescribed risk and uncertainty management practices with projects that are highly complex in nature.

Elements of Project Complexity from Literature

The literature review points to common factors among projects to recognise project or programme complexity, such as complex characteristics, technical compliance, cost over-run, schedule conflicts and political issues (Bosch-Rekveldt et al., 2011; Obicci, 2017; Ramlee et al., 2016). There are several reasons why technical program content may become complex, such as technological and new software development, interfacing with multiple complementary projects and programs, significant systems engineering, and multiple integrated interfaces and users. This item also refers to technologies that are not fully developed and which require more iteration and development once design is completed and construction is underway (Bosch-Rekveldt et al., 2011; Safa et al., 2017). Finance is also often a complexity. This varies from project funding that is inadequate for achieving the desired requirements and how the injected money is actually scheduled for use in the project. Often this is influenced by politicians who, for a variety of reasons, have differing views of projects and their rankings. Negotiation processes within development projects that are complex can mitigate contingencies for financial loss in the testing and development stages (Obicci, 2017).

The third source of complexity is time. Time is a finite resource in all projects and plays a critical part in successful delivery of complex projects (PMI, 2017). For example, complicated or difficult processes in engineering projects can further complicate planned schedules due to unforeseen risks and impacts that are associated with them. Complex projects require the successful completion of critical tasks for the progression of project phases; many

negative impacts can be experienced if there are interruptions in the completion of critical path tasks. To avoid these issues, complex master program plans, detailed schedules and work breakdown structures that connect all the required interfaces need to be developed (Vidal & Marle, 2008). The influence of politics on complexity is layered, as organisations generally deal with federal, state and local governments. Projects are delivered in different policy environments, operational in many different financing arrangements, and have a range of stakeholders, parties, priorities and publics whose needs are varied. Therefore, the requirement of an extensive and detailed political strategy must be designed by the project manager to communicate efficiently with politicians and maintain a positive public image emphasising the importance of the project (Harvett, 2013; De Oliveira *et al.*, 2017).

Each of these elements is the source of limitless variables and the variability of these is generally regarded to the cause of many project problems. Project plans should be designed to be detailed and inclusive, using the optimal mix of skills. Designing these plans to properly reduce risks is essential to maximise the benefit of opportunities without compromising the safety of the project. Project management agility is described as the ability for project managers to react quickly to the emergence of a threat or opportunity and is promoted by project performance evaluation, especially in the context of risk, uncertainty and decision-making.

This literature review examines efficient solutions to improve complex project failure. The results are mixed because not all complex projects fail. An example of this is the successful completion of the Heathrow Airport Terminal 5.

Complex Systems and Project Complexity

There is ongoing debate on the definition of complexity with projects. This is because project complexity is not easy to define and relies upon the unique circumstances of the scenario to warrant its characterisation (Johnson, 2006). The Oxford Dictionary defines the word complex as "consisting of parts" and is "intricate, exhibiting a difficulty to be analysed or disentangled." This is what is meant when complex adaptive systems are pragmatically described to be composed of a large number of components interacting with one another in a complicated fashion, where its size is larger than the total culmination of the smaller components (Ameen & Jacob, 2009; Simon, 1969).

A system of complexity known to contain uncertainty is largely considered to have a structure, with some exceptions. A complex world is highly structured; however, is very difficult to accurately forecast certain events within an unordered world, let alone the location and time of the execution of these events (Goldenfield & Kadanoff, 1999; Nguyen et al., 2015). There is a considerable difference in the meaning behind the terms

complicated and complex, where complicated refers to a knowable system consisting of classifiable behaviour which can be hypothetically anticipated. Systems considered to be complex, however, are described as having an inherently contingent nature of outcomes, which commonly appear as synergistic interactions between internal parts of a coherent whole and result in the nature of the whole becoming unpredictable and possibly unknowable (Bawden, 2007; Marle & Vidal, 2016). The increasing level of complexity in modern projects is thought to be an expected foundational parameter of systems adapting to complexity. The counterintuitive order of a complex adaptive system is one of its fundamental qualities.

As the complexity of projects increases (Chang & Christensen, 1999; Philbin, 2008), there is a recent tendency to highlight the specific limitations that threaten the successful delivery of projects (Cooke-Davies et al., 2007; Ramasesh & Browning, 2014). According to Love et al. (2015, p. 501) "as projects become more complex the likelihood of them experiencing overruns increases." A specific example is the Advanced Research Workshop run by NATO held in Kiev on 1996, which was aimed at modelling and managing complex projects. The workshop focused on the increasing complexity of projects where conventional techniques were proving ineffective and concluded that advanced methods for assessment and management were required (Tanaka, 2014; Williams, 1999). Baccarini (1996, p. 202) defines complexity as "consisting of many varied interrelated parts and can be operationalized in terms of differentiation and interdependency." Baccarini (1996) claims there are two exclusive forms of project complexity: organisational and technological. The interdependencies and differentiation in both of these forms are managed by the principles of integration: control, communication and coordination (Baccarini, 1996).

This work was developed by Williams (1999), who cites Baccarini's work in relation to his definition of project complexity being composed of both organisational and technological complexity. Williams combines these two forms of project complexity into a singular form, structural complexity, and relates the amount of internal objects within a system to their interdependency. The magnitude of structural complexity can have many contributors, which are often the result of multi-objective requirements, trade-offs and the conflicting interests of stakeholders (Williams, 1999; Williams et al., 2012). The number of interdependencies existing between the system's objects does not quantify to the same relevance and importance as the definitions of their unique and specific nature (Papke-Shields & Boyer-Wright, 2017; Williams et al., 2012).

The literature suggests that the three main forms of structural complexity are pooled, sequential and reciprocal output (Harvett, 2013; Nguyen et al., 2015; Williams, 1999; Williams et al., 2012). Pooled

complexity refers to the contribution of the individual elements to the project, while sequential complexity means the conservation of information from one element to another, thereby reciprocating the complexity that describes the output of one element as the input of another. The reciprocal form of structural complexity is known to increase complexity through the interdependencies of its elements. This is due to their tendency to generate dynamic feedback. This ability is a human characteristic that conflicts with the assumptions made in the application of first-generational techniques. For instance, the Programme Evaluation Review Technique (PERT) assumes a steady progress method that is conducted throughout the entirety of a project's life cycle (PLC) (Nguyen et al., 2015; Walker *et al*., 2017).

The structural complexity of a project is composed of another key element, which is uncertainty. Uncertainty is a major compounding factor to the complexity of projects and as a result, it is considered to be an integral component of project complexity (De Araujo et al., 2017; Salah & Moselhi, 2016). However, uncertainty can be viewed separately from complexity as a contributing factor alongside structural complexity to form the sum of the overall difficulties facing project management and therefore represents the entire complexity of the project (Haji-Kazemi et al., 2013; Qureshi & Kang, 2015; Williams, 1999).

According to Pitsis et al. (2014) and Turner and Cochrane (1993), projects can be classified into two primary parameters:

- The degree of accuracy with which the objectives of the project are defined; and
- The degree of accuracy to which the tasks required to complete project objectives are defined.

Due to the wide variety of project types, the implementation of management and project start-up approaches has been required to be updated to the requirements of modern and evolving projects (Harvett, 2013).

Uncertainty is fundamental to the methods of a project. The clarity that methods offer is non-comprehensive and contributes to structural complexity due to the formation of new interdependencies from the re-planning and execution of methods (Remington, Zolin & Turner, 2009). Uncertainty also exists in the definition of project objectives. For example, the success of the project deliverable is not clearly understood in software development, even though the operational processes are well known (Pitsis et al., 2014; Turner & Cochrane 1993).

The objectives and specification of individuals can be difficult to define as they can change over time, especially after the review of preliminary prototypes. Changes and alterations made to project goals in the light of future uncertainty result in the increase of project complexity in two primary forms (Haji-Kazemi et al., 2013; Qureshi & Kang, 2015; Williams, 1999):

1. The actual process of altering project dimensions increases project complexity; and
2. The complexity of the product increases, which in turn increases the complexity of the methods and therefore the entire system.

There are two primary causes that contribute to an increase of a project's overall structural complexity: the interactions concerning product complexity and the project's complexity. As the demand for updated products increases, product models in some industries completely phase out their predecessor, and each generation of the product develops an increased structural complexity (Haji-Kazemi et al., 2013; Qureshi & Kang, 2015; Williams, 1999).

The three most valuable concepts of complexity derived from theoretical and empirical assessments of the widely accepted model of uncertainty and structural complexity are faith, fact and interaction (Geraldi & Albrecht, 2007; Harvett, 2013). Faith incurs high uncertainty, as is often creates something new and unique, while fact refers to the interactions with a large amount of independent information. Interaction has a reciprocal relationship with faith and fact and focuses on the interfaces between these states (Geraldi & Albrecht, 2007; Harvett, 2013). A study conducted by researchers Geraldi and Albrecht (2007) investigated project managers operating within an engineering facility and drew conclusions from the emerging patterns of complexity during the life cycle of the project. The empirical data suggests similar patterns exist in the contribution to project complexity from the interactions that occur between fact and faith.

Philbin (2008) undertook research in the United Kingdom (UK) concerning managing the increasing complexity inherent within most engineering and technologically-based projects. Philbin prescribes a tool designed to manage the complexity of projects called the Imperial Colleges system view. This framework is composed of four primary pillars: the design for an integrated system, the integration of systems, systems architecture development and system-of-systems management, in an effort to adjust to the increase in project complexity. This framework was derived to reinforce the theory level of the systems and to develop a reciprocal relationship with the enterprise, which highlights the requirement to apply the business aspects of a project to the same level of complexity as its technical aspects (Philbin, 2008).

Measuring Project Complexity

In this section, the models designed to measure the complexity of projects are detailed, particularly the "Crawford-Ishikura factor table for evaluating roles" (CIFTER) (Aitken et al., 2007; Harvett, 2013), the "Analytic Hierarchy Process" (AHP) (He et al., 2015; Vidal et al., 2011), the "Technological, Organisational and Environmental framework" (TOE)

(Bosch-Rekveldt et al., 2011, 2015) and "Uncertainty-Complex-Pace" model (UCP) (Lester, 2017; Shenhar & Dvir, 1996).

The UCP model was designed by Shenhar and Dvir (1996) as a tool to quantify project complexity. The researchers use three terms to characterise the complexity of project models: assembly, system and array. The assembly is a subsystem designed for the operation of a single function, while a system is a collection of subsystems performing numerous functions. Finally, the array is defined as a vastly wide interconnecting network of collection systems programmed for a similar goal (Lester, 2017; Nguyen et al., 2015).

Recent models developed to quantify project complexity include the AHP (He et al., 2015; Videl et al., 2011) and the framework for the TOE (Bosch-Rekveldt et al., 2011, 2015). The AHP is a technique established by researchers Vidal et al. (2011). Comparisons between project size, interdependencies, variety and context-interdependence result in the measurements of project complexity. A recent case study revealed the resulting index of complexity overcame the capacity for the level of complexity and as a result the technique is considered to be reliable, intuitive and user friendly. However, there were significant inconsistencies with the study, as it was conducted in a particular context and operated with low levels of experience within the organisation, which resulted in the varied quality of comparisons made (Vidal et al., 2011).

The TOE framework analyses existing literature and case studies to characterise project complexity in the engineering industry (Bosch-Rekveldt et al., 2011, 2015). The TOE is composed of three separate categories containing a total of 50 elements, which provide a complexity footprint. The overall objective for employing this framework is to accept more efficient front-end development steps for projects of particular complexity. One of the limitations of the TOE framework is that it is not well suited for projects that are highly technical in nature (Bosch-Rekveldt et al., 2011, 2015).

The CIFTER framework is an extensive approach covering both the organisational and technical aspects of project management. CIFTER also looks at the relationships between project objects in a professional atmosphere. The CIFTER technique contributes to the "Global Alliance for Project Performance Standards" (GAPPS) and is composed of seven factors. These are the responsibility for providing stability within the scope of the project; a collection of methods, techniques and practices that define the approach for the operation of the project; the environmental, legal and social impacts that are caused from the operation of project development; the overall perceived financial impacts that will affect stakeholders; the strategic benefits of the project that are available to the organisational body; continued stakeholder interaction and cohesion in respect to the project's product

characteristics; and a series of interfaces to facilitate interactions between the internal and external elements of a project (GAPPS, 2007).

Research into a range of projects was undertaken to test CIFTER as a technique to characterise projects in relation to their complexity. By using the CIFTER model to assess and allocate project complexity, the effectiveness of the project manager's ability to handle the assessment of complexity can be promoted (Aitken et al., 2007; Harvett, 2013; Lu et al., 2015). A significant element in this concept is that the magnitude of complexity can be characterised by the perception that people have of it (Aitken et al., 2007; Lu et al., 2015).

CIFTER is considered to be an effective tool with a composite and broad focus for assessing project management complexity. It forms part of a global standard and is a consistent and valid technique for application by both independent investigators and the project management team.

Uncertainty and Risk in Complex Project

Defining uncertainty and risk in relation to their role in project management is crucial in developing a clear and effective risk management strategy (Harvett, 2013; Sanderson, 2012; Walker et al.,2017). There are two key concepts that impact the effectiveness of describing uncertainty: the volume and complexity of information and the patterns of probability and randomness (James et al., 2006; Kaplow & Weisbach, 2011). There are three main views on the nature of complexity: the classical mindset, which focuses on project objectives and the external environment; transition, which explores the relationship between internal and external project elements; and process uncertainty, which covers the perception that decision-making is impacted majorly by internal factors (Bloom, 2014; Jauch & Kraft, 1986).

Uncertainty consists of ambiguity and volatility as key factors (Song et al., 2017). Ambiguity can be described as the absence of transparent data about external parameters, the uncertainty of cause-effect interactions, and the uncertainty of methods or practices and their perceived impacts. Volatility is defined as the unpredictable impacts or rates at which the environment can produce or change at and is a constant source for uncertainty surrounding unknown or future events (Carson et al., 2006; Song *et al.*, 2017; Walker *et al*., 2017).

Alongside ambiguity, variability is evident in uncertainty (Smithson, 2015; Ward & Chapman, 2003), where variability refers to scenarios that produce a wide range of values for a unique quantifiable parameter. A perfect example of this is the roll of a six-sided dice, which will always produce a single unique result. This form of uncertainty is referred to as aleatoric, which is the definition of an event with variable uncertainty within a range of foreseeable outcomes, i.e between 1 and 6. This result is known as 'the dice

will roll and a result between one and six will occur', but there is still uncertainty due to the variable nature of the result (Hillson, 2004; Song et al., 2017). Ambiguity, on the other hand, is used to describe the unquantifiable measure of uncertainty, where uncertainty refers to an associated meaning (Bloom, 2014; Walker et al., 2017). The problem in this scenario is that it is not the probability or particular result of an event, but rather the transparency of the event itself. This type of uncertainty is often the result of poor communication and is referred to as epistemic, meaning the vague or partial knowledge about the issue being discussed. The early stages of projects are often the phases of PLC where ambiguity and variability are most easily identified (Atkinson et al., 2006; Harvett, 2013; Pushkarskaya et al., 2015).

The importance of considering human epistemological expectations in relation to cognitive decision-making and an individual's perception of the behaviour of the future is essential in the accurate assessment of risk (Liu et al., 2016; Sambasivan et al., 2017). Inconsistencies with individuals' views on the classification of risk promotes concern that significant factors surrounding project functionality could be omitted from decision-making due to an imbalance of management attention focusing on the planning, operation and control of strategic assets (Bloom, 2014; Sanderson, 2012). Table 1 below displays a collaborative categorisation of differences between uncertainty and risk, which are characterised in relation to the assumptions held by decision-makers (project managers) on the predictability of future events (Sanderson, 2012).

Table 1: Assumptions on the views of the decision-maker in relation to the uncertain events

Risk/Uncertainty Category	**Decision-Makers' View**
Risk Category 1: a priori probability	The decision-maker believes they are capable of calculating the mathematical probability of potential events based upon the sound application of mathematical laws and algorithms. For example, the probability of rolling a one on a six-sided dice is clearly one in six.
Risk Category 2: statistical probability	The decision-maker believes they are capable of attaching objective probabilities to the likelihood of future events based upon evidence gathered on the statistical probability of similar events in the past. For example, being struck by lightning or being involved by a motor collision.
Uncertainty Category 1: subjective probability	The decision-maker faces a wide range of potential future events but does not possess the information required to assign an objective probability to an event, therefore they assign estimates on the grounds of historical industry expectations in the subjective probability on the likelihood of future events.
Uncertainty Category 2: socialised	The decision-maker faces a wide range of scenarios where the number or nature of future events is unknown. This is not due to the difficulty in understanding the specifics of the data but rather lies in the volume of relevant information available to the decision-maker. It should always be clear to the decision-maker that the future is by definition unknowable, a conclusion supported by the nature of the futures social construction.

Source: Sanderson (2012)

As previously stated, it is highly important to assess human perceptions and reactions when managing for risk and uncertainties in complex projects (Qureshi & Kang, 2015; Zhang, 2011). Although risk is acknowledged to be a result of uncertainty, this does not mean that risk and uncertainty are theoretically synonymous, as risk is "an outcome which can be calculated through measuring probabilities" and uncertainty "concerns the unknown future" (Rutherford, 2002, p. 182). The conclusion arrived at is that there exists a continuum between these concepts which varies in magnitude proportionate to the level of knowledge and calculations (Sanderson, 2012). Risk is the product of events regarded as having known outcomes, while uncertainty exists in events with unknown probabilities and outcomes.

Conclusion

There is limited evidence in the literature of empirical research focused primarily on the management of risk and uncertainty with complex projects. Specifically, the project manager's risk and uncertainty management practices, together with the inter-relationships between risk and uncertainty management practice and measures of complex project success. The combination of continuing project failures, increasing project complexity and inadequate risk and uncertainty management processes and practices establishes of doing this paper.

This paper discussed the elements of project complexity from literature such as, complex characteristics, technical compliance, cost over-run, schedule conflicts and political issues. In addition, the paper defined complex systems and project complexity. The three most valuable concepts of complexity derived from theoretical and empirical assessments of the widely accepted model of uncertainty and structural complexity are faith, fact and interaction. Furthermore, this paper described the measurement of project complexity by using CIFTER, AHP, TOE and UCP methods. Finally, this paper dedicates itself to investigating the practices used by project managers to manage for risk and uncertainty and examines efficient solutions to improve complex project failure.

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