Understanding the Variables Influencing the Adoption of the Blockchain Technology.

Master Thesis

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"*The highest human act is to inspire…*" Ermias "**Nipsey Hussle**" Asghedom

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Abstract

The emergence of the blockchain technology remains strangely similar to the one experienced in the early 90's with the Internet. Some people argue that the potential of the blockchain technology can be greater than the World Wide Web, especially because of the impact it can provide through its key features of establishing trust among parties, eliminating the middleman through a decentralized approach and the traceable, transparent and highly secured network among many things. It is mainly argued that the blockchain technology is at its nascent stage, which makes it more convenient to study its adoption. This paper greatly follows the blueprint provided by Arias-Olivas' *et al.* (2019) research paper on the variables influencing the adoption of the cryptocurrency. In this paper however, it has been first decided to determine the strength and direction of the relationship between significant predictors and the intention to use through both a correlation test and a regression. This paper aims to test how accurately (or not) UTAUT model, as a fundamental theory on technology adoption, also applies to the blockchain technology and to identify the key difference(s) towards the variables influencing the adoption of a technology.

Several hypotheses are illustrated in this paper. Firstly, it has also been hypothesized in this paper that the intention to use the blockchain technology is positively and strongly influenced by the performance expectancy, effort expectancy, social influence, and/or facilitating conditions. In order to verify those hypotheses, it has been decided to create and share an online questionnaire that gathered a total of 144 responses. Based on their responses, both a Pearson test and hierarchical multiple regression analysis have been performed in order to determine how meaningful and significant the independent variables, as well as several descriptive variables, can be towards the intention to use the blockchain technology in order to identify the key elements of a potential and greater scale of diffusion to the masses.

In reference to results from the Pearson correlation test on the one hand, each variable has been proven to strongly and positively influences the intention to use the blockchain technology where both the performance expectancy and social influence respectively displayed the highest degree of correlation. On the other hand, the outcome from the hierarchical multiple regression highlights the fact that both "awareness" and "self-labelling" are descriptive variables that have a significant moderator effect on the relationship of the independent variables and the intention to use the blockchain technology. Moreover, the sample has overall provided a positive response to the intention to use the blockchain technology since its

arithmetic mean is 4.6 on a scale from 1 (strongly disagree) to 7 (strongly agree), which can be translated into “somewhat agree” on the willingness to use the technology.

These findings are discussed in the final chapter where also some suggestions are given for developers and blockchain entrepreneurs to raise awareness among potential adopters and provide them with a community to support them.

Table of content

Introduction

"What is the Internet anyway?". This question was desperately asked by Bryant Gumbel, an American television journalist and sportscaster, best known for his 15 years as co-host of NBC's Today. Indeed, defining and describing what the Internet consists of was highly challenging for a vast majority of people living in "developed" countries such as the United States of America in the early 90's.

Nowadays, around the World and despite its unequal distribution, there are 4.39 billion internet users in 2019, an increase of 366 million (9 percent) versus January 2018.[1] The Internet, or World Wide Web (WWW) is an indispensable tool for billions of people in order to work, connect and/or make a living. This clearly demonstrates the diffusion of innovation theory (DIT) developed by Rogers. In his book, he suggests that patterns of Information and Communication Technology (ICT) acceptance within a network of users are shaped through a process of communication and social influence; later adopters (imitators) are informed of the utility (innovation) of a new ICT by earlier adopters (Rogers, Diffusion of innovations., 2010). In their paper, Lee *et al.* (2013) argue that as earlier adopters are less affected by communication and social influence, their intention to use a technology is mostly encouraged by innovation factors that are closely associated with users' perceptions such as usefulness, ease-of-use and self-efficacy; on the other hand, later adopters' intention to use is driven more by imitation factors, like subjective norm and word-of-mouth, than innovation factors through communication and social relationships. Similarly, Arias-Olivas *et al.* (2019) highlight in their research, the different factors on the adoption of the cryptocurrency throughout a literature review and describe that perceived usefulness is the most influential factor in the intention to use cryptocurrencies for electronic payments, but find no support for the direct effect of social influence on the intention to use them.

It is worth reminding the evolution of the Internet in its early days up until now and the diffusion of innovation theory in this introduction because we argue that History seems to be repeating itself through the recent introduction of the blockchain technology. Indeed, in their paper, O'Dair & Owen (2019) combine different sources to provide a holistic definition of the blockchain technology; defining it as a "type of distributed ledger" composed of a chain of cryptographically linked 'blocks' contained in batched transactions (Hileman & Rauchs,

1 Kemp, S. (2019, January 30). Digital 2019: Global Internet Use Accelerates. Retrieved from https://wearesocial.com/blog/2019/01/digital-2019-global-internet-use-accelerates

2017). The technology first emerged underpinning the digital currency, Bitcoin (Nakamoto, 2008); although it is now acknowledged that block chain's importance extends far beyond Bitcoin (Kewell & Michael Ward, 2017), it remains most widely discussed in the context of financial services. Yet blockchain technology provides an exciting application space for innovation in diverse domains (Adams, Parry, Godsiff, & Ward, 2017), including social and solidarity-based finance (Scott, Loonam, & Kumar, 2017), global development (Adams, Parry, Godsiff, & Ward, 2017), and business and management (White, 2017). Blockchains and other distributed ledger technologies are creating fresh opportunities for value creation and capture (Maull, Godsiff, Mulligan, Brown, & Kewell, 2017), disrupting governance structures (Shermin, 2017) and reconfiguring the global economy (Manski, 2017).

One could argue that the technology adoption life cycle consists of 2 psychological mindsets, namely the “early market” composed by innovators and early adopters, and the “mainstream market” with the early, late majority and the laggards. According to Mori (2016), only 20 percent of the barriers to adopt blockchain technologies are technology based, while the other 80 percent are attributable to business and communication-based practices. As Frizzo-Barker *et al.* (2019) argue in their paper, there is a need for research on the social, economic, and ethical dimensions of blockchain adoption and diffusion. That is the reason why the main goal of this paper is to determine which variables have the greater chances to have an impact on the adoption of the blockchain technology.

Theoretical and Practical Contributions

This paper aims to contribute to its field both on a theoretical and practical level. Firstly, from a theoretical viewpoint, it will be interesting to see if the blockchain technology differs, one way or another, from previous technology, product and/or service innovations prior to it. Applying such a proven theory on the intent to use an innovation would confirm (or not) the potential of such an innovation on a greater scale and determine whether or not that latter has moved past the infant stage and is ready to move forward to its next growth stage. Moreover, while authors like Queiroz & Wamba (2019) have investigated the challenges faced by the blockchain technology adoption in supply chain in the US and India, we will be focusing on a more holistic level, providing elements of comparison.

Secondly, this master thesis could be of practical use for blockchain entrepreneurs willing to understand what potential customers value and take into consideration when it comes to using the blockchain technology in order to increase their chance to attract as many users as possible. Moreover, policy makers can find practical contribution since in their paper, O'Dair & Owen (2019) argue than one of the two apparent avenues for future development which may indeed enable new entrepreneurs to raise money on the blockchain is the development of effective light touch regulation that can gain blockchain industry buy-in. Hence, understanding blockchain potential audience from a scientific perspective can help achieve that very goal.

Central Question

Following question is set as a guideline to fulfil this aim: **what is the strength of the relationship between the performance expectancy, effort expectancy, social norm, and facilitating conditions with the intention to use blockchain technology?**

Theoretical Framework

Overview of the Unified Theory of Acceptance and Use of Technology (UTAUT)

When it comes to explaining how an innovative and emerging technology is accepted by people and organizations, both the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003) and its extension UTAUT 2 (Venkatesh, Thong, & Xu, 2012) are referential theories. Indeed, in their papers, Arias-Olivas *et al.* (2019) argue both are based on Technology Acceptance Models (TAM and TAM2), which, in turn, are rooted in the theory of reasoned action (TRA) and the theory of planned behavior (TPB).

Firstly, on the one hand, the theory of reasoned action (Fishbein & Ajzen, 1975) posits that behavioral intentions, which are the immediate antecedents to behavior, are a function of salient information or beliefs about the likelihood that performing a particular behavior will lead to a specific out; while on the other hand, the theory of planned behavior (Ajzen, 1985) extends the boundary condition of pure volitional control specified by the theory of reasoned action, which Madden *et al.* (1992) explain this is accomplished by including beliefs regarding the possession of requisite resources and opportunities for performing a given behavior.

Secondly, in an article, Davis (1989) referred the *technology acceptance model* (TAM) to as an information systems theory that models the decision-making process by which users may or may not adopt and implement a new technology. In this research, UTAUT and its extension are used in order to allow us to describe a positive and direct influence of several factors on the intention to use a technology, namely: the performance expectancy, effort expectancy, social norm, and facilitating conditions, which will be described, used and tested in this research on the adoption of the blockchain technology in Europe.

Finally, because the blockchain technology is often described as an innovative, infant and/or disruptive technology, it is believed that such a theory could explain the blockchain phenomenon to some extent and is going to be used as the fundamental theory of this paper and the backbone of the questionnaire used to collect data in this research.

The Blockchain Technology

The blockchain technology is now synonymous of novelty. Like the internet in its early days, the blockchain technology is often described as a disruptive technology that is expected to be the cornerstone of new types of business and social interaction. It is already affecting these latter, through its decentralized architecture, trustless and permissionless systems, smart contracts, as well as data, privacy, and information management (Frizzo-Barker, et al., 2019). In that same research paper, authors remind us that the blockchain is a decentralized, digital ledger that facilitates peer-to-peer value transfers of all sorts, from digital currency to physical commodities and land titles, without the need for an intermediary such as banks, accountants, or lawyers. In more technical terms, the blockchain technology is a sequential distributed database where the entire earlier transaction history is stored and shared in a (block) chain in a public ledger [2]. Blockchains are normally used with cryptocurrencies and the most well-known of those is the Bitcoin. Indeed, the blockchain technology was initially introduced in 2009 through the release of its most popular application: Bitcoin, by a person - or a group - calling himself or themselves Satoshi Nakamoto. Their goal was to create a new kind of digital currency that was decentralized and removed the control of governments, banks, and other traditional financial institutions (Nakamoto, 2008). Thus, the relatively short history of the blockchain technology is offering innovative solutions able to drastically change how certain things are executed in the world.

Those contemporary outcomes are made possible through characteristics key features, namely; cryptography and “smart” contracts. Firstly, in his thesis, UTwente alumni Frank (2018) argues that a blockchain is built on two very important cryptographic foundations, namely: the hash functions as well as the public-private key encryption. On the one hand, hash functions allow to create a digital fingerprint of the data. The algorithm takes an arbitrary input and converts it into a fixed length output (Frank, 2018), for instance, the sentence: ”The quick brown fox jumps over the lazy dog” becomes: ”4d741b6f1eb29cb2a9b9911c82f56fa8d73b04959d3d9d222895df6c0b28aa15”, and when adding a single white-space at the end: ”The quick brown fox jumps over the lazy dog ”, the outcome becomes:

2 van Eyk, V. (2014, September 30). A Q&A with the CEO of BitNation. Retrieved from https://bitcoinmagazine.com/articles/qa-ceo-bitnation-1412110033

”75f80f0fb49a16e547d5d29e8c145a26a5aea3adda99a49e5c69b858b59ee012”. That is the reason why Frank (2018) highlights the fact that changing even one white-space will result in a completely different outcome. On the other hand, The Public and Private key pair comprise of two uniquely related cryptographic keys (basically long random numbers). The Public Key is made available to everyone via a publicly accessible repository or directory. On the other hand, the Private Key must remain confidential to its respective owner [3]. Lindman *et al.* (2017) argue that the idea of the bitcoin system is that the entire earlier transaction history is verified by solving a cryptographic computation.

Secondly, the blockchain is changing the nature of social relations and organizations in a World that can be described as a global village. Blockchain is changing the interactive effect of human relations by facilitating trustless technologies such as the smart contract. A smart contract removes the need to build trust between individuals and organizations through intermediaries like lawyers and social activities like meetings where actors get to know one another. Smart contracts build the transactional relationship of a contract into technical code that is executed automatically (Frizzo-Barker, et al., 2019).

Finally, and through all those technicities, blockchain can potentially enhance industries practices. For instance, Barber *et al.* (2012) argue that financial instruments, such as payments, trading records and smart contracts can be built on blockchain technology, as depicted in **Illustration 1**, which then prevents adverse behavior and repercussions, such as double-spending, forgeries and false disputes. Furthermore, the technology can be used for legal and public records, such as titles, birth certificates, voting or court records, and can also be used for creation of “smart property” in which case blockchain becomes an inventory, tracking and buy- sell mechanism for hard assets like diamonds or cars (Lindman, Tuunainen, & Rossi, 2017). Consequently, it is highly and rightfully believed that the blockchain technology has the potential to be as disruptive as the internet, thus our concern to analyze its future possible adoption and willingness to test our hypotheses.

[3] Public Keys and Private Keys - How they work with Encryption | Comodo. (n.d.). Retrieved from https://www.comodo.com/resources/small-business/digital-certificates2.php

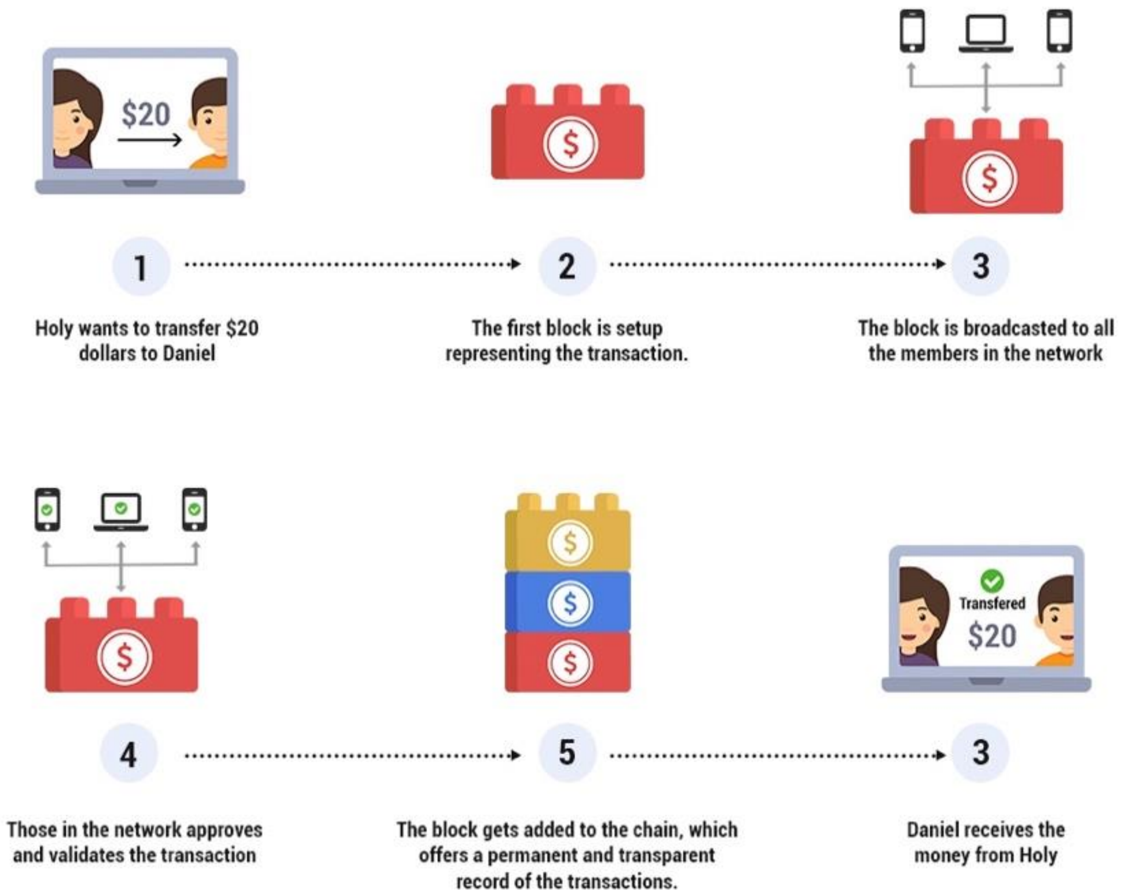


Illustration 1 How does the blockchain work?

Hypotheses

This research underpins the UTAUT model in the context of blockchain. That latter provides theoretical guidance for the development of research propositions for the adoption and use of blockchain technologies. Thus, the constructs of UTAUT model therefore is used in this study to develop the theoretical model to adopt the blockchain technology.

Several studies have got different results regarding the impact of several variables on the adoption of a technology. For instance, Hussain *et al.* (2019) find that performance expectancy, effort expectancy, facilitating conditions, and social influence all significantly influence behavioral intention. Additionally, in their research on the adoption of the mobile banking in Bangladesh, Mahfuz *et al.* (2016) show that effort expectancy and social influence are the most significant antecedents of behavioral intention. However, depending on the sample and geographical location, there can be distinctive outcomes. For instance, on the one hand and as mentioned in the introduction, in their paper, Arias-Olivas *et al.* (2019) claim that perceived usefulness is the most influential factor in the intention to use cryptocurrencies for electronic payments, but find no support for the direct effect of social influence on the intention to use them. Whereas, on the other hand, in an acceptance study in China, Shahzad *et al.* (2018) find that both perceived usefulness and perceived ease of use significantly influence the intention to use a cryptocurrency such as bitcoin. It is also worth mentioning that any new research on this topic must be understood and interpreted with the notion it is not the specific innovation as such that determines the diffusion of that innovation, but it surely also depends on social context and demographic characteristics of society.

Performance expectancy

Performance expectancy is defined as the degree to which a person considers that using a specific technology would be useful to enhance his or her performance. It can indeed easily be assumed that the more a user using a technology improves their performance, the intent to use it increases. Williams *et al.* (2015) claim that performance expectancy and behavioral intention are the best predictors for using technology. Moreover, in their paper, Barlett *et al.* (2007) demonstrate that increased transparency results in greater performance because participants were able to plan better due to greater visibility of their impact upon the supply. Which is particularly convenient in this case since it has been demonstrated that the Blockchain offers a solution for a trusted single-source of distributed information with improved information accuracy and efficiencies that provides asset managers more opportunity to scale and deploy resources (Swink & Schoenherr, 2015). Thus, our first hypothesis:

H1. Performance expectancy regarding using the blockchain technology positively and strongly influences the intention to use it.

Effort expectancy

Effort expectancy is defined as the degree of ease associated with the use of a specific technology. In his research, Arvidsson (2014) finds that the most important predictor of mobile payment adoption is ease of use and indeed, it is fair to assume that individuals are less likely to use technology if it is sensed to be more difficult to use and require effort than existing methods. Effort Expectancy and Performance Expectancy are closely related; however, the former is more closely aligned with efficiency expectations and the latter with effectiveness (Brown, Dennis, & Venkatesh, 2010). As described in the previous chapter, blockchain enables the use of “smart contracts” that are based on user defined rules requiring little to no human intervention. Hence, our second hypothesis:

H2. Effort expectancy regarding using the blockchain positively and strongly influences the intention to use it.

Social influence

Social influence is defined as the degree to which a person perceives that others believe that he or she should use a specific technology. Indeed, in their research, Moon & Hwang (2018) show that social influence positively affect the intention to use crowdfunding and since the blockchain technology can be described as a “social” technology by design in consideration of its goal to reinstall trust among people through transparent transactions. For this reason, it is worth verifying how such influence could impact the intention to use the blockchain technology. Thus, the hypothesis based on SI is:

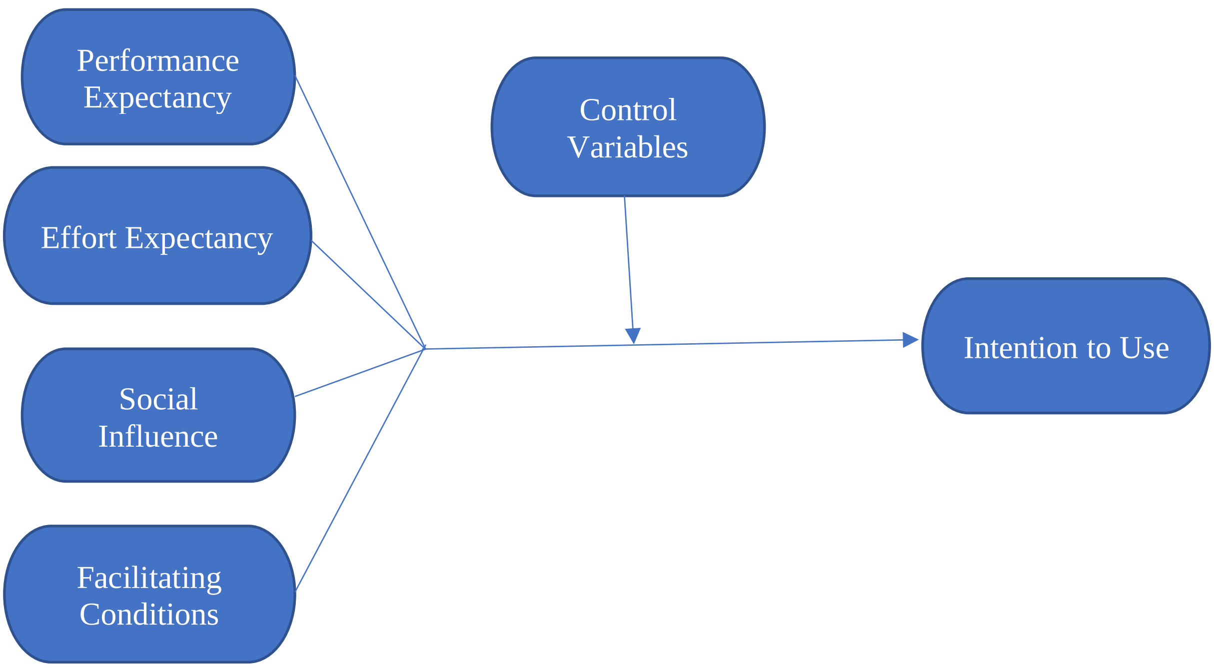
H3. Social influence regarding using the blockchain positively and strongly influences the intention to use it.

Facilitating conditions

Facilitating conditions are defined as the degree to which a person believes that he or she has the necessary organizational and technical infrastructure to use a specific technology. (Venkatesh, Morris, Davis, & Davis, 2003). The highly networked nature of blockchain applications necessitates the availability of technical resources to enable use; a lack of resources will negatively affect its use (Francisco & Swanson, 2018). Hence the final hypothesis being:

H4. Facilitating conditions for using the blockchain positively and strongly influences the intention to use it.

Figure 1 The conceptual model for research



Research Design: Methodology

Overview

In this research, a quantitative study is made since there already is a basis of existing studies on UTAUT theory that can be built upon. Furthermore, in business studies, survey method of primary data collection is used in order to reflect attitude of people [4], which can result being ideal to understand and describe the decision-making process of an individual to adopt the blockchain technology. More specifically, in order to gather large size of information in a relatively short period of time, the survey method for this paper will be made through the use of a questionnaire since that latter offers some advantages namely:

- Large amounts of information can be collected from a large number of people in a short period of time and in a relatively cost-effective way.
- Can be carried out by the researcher or by any number of people with limited affect to its validity and reliability.
- The results of the questionnaires can usually be quickly and easily quantified by either a researcher or through the use of a software package.
- When data has been quantified, it can be used to compare and contrast other research and may be used to measure change.
- Positivists believe that quantitative data can be used to create new theories and/or test existing hypotheses. (Kabir, 2016)

Because of those above-mentioned benefits, a questionnaire is repeatedly distributed in researches involving the UTAUT theory, which makes it a favorable theoretical tool to conduct to use one for this paper.

[4] Research Methodology. (n.d.). Survey Method. Retrieved from https://research-methodology.net/research-methods/survey-method/#_ftn1

Questionnaire

A questionnaire will be necessary to collect data on variables from the UTAUT. Indeed, a total of 27 questions concerning the performance expectancy, social influence, facilitating conditions and effort expectancy have been asked in order to determine any relationship towards the intention to use the blockchain technology and therefore confirm and/or reject our different hypotheses. The questions were inspired by existing research (Arias-Oliva, Pelegrín-Borondo, & Matías-Clavero, 2019). Surveys are interpersonal channels in which respondents have to be identified (Grover, Kar, & Janssen, 2019), which is the reason why the questionnaire of this research started with control variables helping us to identify respondents and have a better picture of the sample as whole as presented later in this paper.

The questionnaire was created with Qualtrics. At the beginning of the questionnaire, an introduction about the blockchain technology had been provided, then respondents are required to inform us if (1) they had ever heard of it and (2) they have considered themselves either as a non-adopters or early adopters, so that it provides us further elements on the characteristics of our sample profiles as described later in this research paper. The questionnaire was active from Tuesday, December 17th, 2019 to March 23rd, 2020 but truly had two significant rounds of responses collection, where the first peak allowed us to collect 27 answers from direct colleagues of the author in December before Christmas break. However, in order to collect as many responses as possible, it had finally been decided to send a general invitation to participate on several social medias such as LinkedIn and Facebook from the account of the author of this research, from which a total amount of 144 responses have been collected.

As mentioned in the introduction, just as the internet in its early days, only a few people truly grasp what the blockchain technology consists of, that is the reason why we find it insightful to provide this questionnaire to as many people as possible. We based our measurement scales on scales that are widely used and accepted in the literature on technology acceptance. **Table 1** shows the constructs, items as well as their respective theoretical foundations. It is worth mentioning that all 16 items were scored on a scale point from 1 to 7, respectively; 1 is “strongly disagree”, 2 is “disagree”, 3 is “somewhat disagree”, 4 is “neither agree nor disagree”, 5 is “somewhat agree”, 6 is “agree” and 7 is “strongly agree”. Then, items from the same construct were combined into new four variables: IU for intention to use, PE for performance expectancy, EE for effort expectancy, SI for social influence and FC for facilitating conditions on the same scale point from 1 (Strongly disagree) to 7 (Strongly agree), in order to have a more accurate view since the aim of this paper is to describe the relationship between the variables of the UTAUT model and the intention to use the blockchain technology.

Table 1 Constructs and theoretical origins

Construct/ Item	Theoretical foundation
Intention to use I intend to use the blockchain technology I predict I will use the blockchain technology	TAM2 scale (Venkatesh, Morris, Davis, & Davis, 2003)
Performance expectancy Using the blockchain technology will increase opportunities to achieve important goals for me. Using the blockchain technology will help me achieve my goals more quickly. Using the blockchain technology will increase my standard of living.	Adapted from the UTAUT2 scale (Venkatesh, Thong, & Xu, 2012)
Effort expectancy. It will be easy for me to learn how to use the blockchain technology. Using the blockchain technology will be clear and understandable for me. It will be easy for use to use the blockchain technology. It will be easy for me to become an expert in the use of the blockchain technology.	Adapted from the UTAUT2 scale (Venkatesh, Thong, & Xu, 2012)
Social influence. The people who are important to me will think that I should use the blockchain technology. The people who influence me will think that I should use the blockchain technology.	Adapted from the UTAUT2 scale (Venkatesh, Thong, & Xu, 2012)

People whose opinions I value would like me to use the blockchain technology.	
Facilitating conditions. I have the necessary resources to use the blockchain technology. I have the necessary knowledge to use the blockchain technology. The blockchain technology is compatible with other technologies that I use. I can get help if I have difficulty using the blockchain technology	Adapted from the UTAUT2 scale (Venkatesh, Thong, & Xu, 2012)

Sample Profile

The sample consisted of 144 people. The number of respondents in general is rather satisfying when following Tabachnick's rule and the general rule of thumb for multiple linear regression. Indeed, one the one hand, Tabachnick *et al.* (2007) give a formula for calculating sample size requirements, taking into account the number of independent variables that one wishes to use: $N > 50 + 8m$ (where m = number of independent variables); when on the other hand, a rule of thumb for the sample size is that regression analysis requires at least 20 cases per independent variable in the analysis[5]. Before analyzing the results, a description of the sample is provided for a better understanding of the composition of that latter. Thus, self-labelling has been used as a descriptive variable in order to have a greater grasp onto how both self-labelled "blockchain enthusiasts" and "non-adopters" differ from one another when analyzed with other control variables. Control variables are those that which will be reported on, without relating them to anything in particular[6]. For instance, a majority of men composed the blockchain enthusiast group (67%) with a total of 42 technology friendly respondents, and out of 87 respondents in the other group, up to 56% of self-labelled non-adopters are women. Furthermore, the main group consists of people ageing from 23 to 37 years old also known as

[5] Assumptions of multiple linear regression. (n.d.). Retrieved from https://www.statisticssolutions.com/assumptions-of-multiple-linear-regression/

[6] Variables in research. (n.d.). Retrieved from https://changingminds.org/explanations/research/measurement/variables.htm

“Generation Y” in both blockchain enthusiasts and non-adopter groups. Moreover, a large majority of participants are qualified with a university degree ranging from a bachelor to PhD, wherein the dominant diploma in both groups remains the bachelor level: 45% of non-adopters and 49% of blockchain enthusiasts. Even though a majority of respondents affirm having been aware of the blockchain technology before taking part of the actual questionnaire, about 67.4% of them consider themselves as non-adopters. There was a small deviation with regard to gender in general, with 2% more men than women (51% men). Finally, the breakdown of net monthly household income for the sample was as follows: both groups count a majority of people who earn less than 1,000€ net per month, 21% of blockchain enthusiasts and 37% of non-adopters. As can be seen, income levels were quite moderate, which is reasonable given that the sample consisted of college-educated adults and young professionals, who are more likely to earn their first entry-level salaries. The impact of those control variables will be highlighted later on in this research paper. Finally, as described earlier in the questionnaire section, the response rates have reached two peaks during its publication time. One was in December 2019 where the first 27 respondents were solely EF Education First employees, colleagues of the author and the second highest response rate in March 2020 was attained through a general invitation to participate to the questionnaire on the author’s Facebook account. It would therefore be fair to assume that this sample rather similar to the author, thus mainly representative students/ young professionals active on social medias living within Europe.

Statistical Methodology

The selection of the statistical analysis is a critical step of the research. Indeed, as of the proposed explanatory model for the intention to use the blockchain technology, a hierarchical multiple regression will be implemented and its assumptions will be checked in order to test all hypotheses, namely through the distribution normality. Indeed, a test of normality has been executed in order to determine whether or not the data is normally distributed, hence its null hypothesis stating the population is normally distributed. However, the result of this analysis as described in **Table 2** has been significant, rejecting the null hypothesis, therefore concluding that the data is not with a normally distributed, violating one of the assumptions. However, it has, however, been decided to pursue that statistical test since it can be argued that, when a dependent variable is not distributed normally, linear regression remains a statistically sound technique in studies of large sample sizes (Li, Wong, Lamoureux, & Wong, 2012). Since it has been proven that the distribution is not normal, a Spearman's rank correlation coefficient has first been executed in order to measure the strength and direction between each variable and the intention to use through a bivariate analysis as illustrated in **Table 8** in the following section on results.

Table 2 Test of Normality

Test of Normality			
Shapiro-Wilk			
	Statistic	Df	Sig.
Intention to Use	,912	128	,000

Secondly, in order to verify the second part of each hypothesis, both the multicollinearity and the correlation with the outcome variable (dependent variable) are tested. On the one hand, multicollinearity refers to a situation in which at least two explanatory variables in a multiple regression model are highly linearly related. It is generally believed that there is a perfect multicollinearity if, for example as in the equation above, the correlation between two independent variables is equal to 1 or -1. As illustrated in **Table 3**, every variable displays significant and positive results since correlations among one another are inferior to ,7. On the other hand, on the same table, each variable has a correlation value superior to ,3, which is satisfying to confirm that assumption.

Table 3 Multicollinearity

Correlations						
		Intention to Use	**Performance Expectancy**	**Effort Expectancy**	**Social Intention**	**Facilitating Conditions**
Pearson Correlation	**Intention to Use**	1				
	Performance Expectancy	,781	1			
	Effort Expectancy	,490	,457	1		
	Social Intention	,608	,643	,435	1	
	Facilitating Conditions	,460	,434	,542	,358	1

Results

Before analyzing the outputs of the Pearson and hierarchical multiple regression, it is crucial to interpret the collected data. When evaluating as a **whole sample**, therefore independently of any control variable, the arithmetic mean of the intention to use the blockchain technology is 4.6 on a scale from 1 (Strongly disagree) to 7 (Strongly agree), which can be interpreted as if this sample somewhat has the intention to use the blockchain technology. The descriptive has been tested this way since no accurate way to measure if someone is either a blockchain enthusiast or a non-adopter has been used. Eventually being highly objective, this could potentially have a negative impact on the accuracy and validity of the data and results of the research. Within the next sections, an explanatory model is developed to understand blockchain acceptance behaviors. With this aim, we proposed the aforementioned model on variables accepted by the scientific and academic community with high explanatory power regarding variability in the intention to use new technologies and products (Arias-Oliva, Pelegrín-Borondo, & Matías-Clavero, 2019).

Constructs / Items	Factor Loadings
Intention to use	
I intend to use the blockchain technology.	0.785
I predict I will use the blockchain technology	0.844
Performance Expectancy	
Using the blockchain technology will increase opportunities to achieve important goals for me.	0.805
Using the blockchain technology will help me achieve my goals more quickly.	0.739
Using the blockchain technology will increase my standard of living.	0.639
Effort Expectancy	
It will be easy for me to learn how to use the blockchain technology.	0.863
Using the blockchain technology will be clear and/or understandable for me.	0.856
It will be easy for me to use the blockchain technology.	0.833
It will be easy for me to become an expert in the use of the blockchain technology.	0.823
Social Influence	
The people who are important to me will think that I should use the blockchain technology.	0.844
The people who influence me will think that I should use the blockchain technology.	0.832
People whose opinions I value would like me to use the blockchain technology.	0.834
Facilitating Conditions	
I have the necessary resources to use the blockchain technology.	0.634
I have the necessary knowledge to use the blockchain technology.	0.545
The blockchain technology is compatible with other technologies that I use.	0.647
I can get help if I have difficulty using the blockchain technology.	0.754

Table 4 Standardized Loadings

Constructs/ Items	**Composite Reliability**	**Cronbach's Alpha**	**AVE**
Intention to use (IU)	0.798	0.875	0.664

Performance Expectancy (PE)	0.773	0.917	0.534
Effort Expectancy (EE)	0.892	0.916	0.674
Social Influence (SI)	0.876	0.924	0.702
Facilitating Conditions (FC)	0.742	0.721	0.422

Table 5 Construct Reliability, Cronbach's Alpha and Convergent Validity (AVE)

Analysis of the measurement model

An exploratory factor analysis was performed to test the number of dimensions included in each scale. Each scale was found to have two dimensions when selecting factors on the steep part of the screen plot (using the Elbow criterion) and four dimensions when selecting factors based on Eigenvalue high than 1 (using the Kaiser's criterion). For all the scales, the Barlett's test of sphericity coefficient had a significance level less than 0.00, the Kaiser-Meyer-Oklin (KMO) statistic, which measures sampling adequacy, was 0.802 as shown on **Table 6**, therefore greater than 0.5 and can be judged as adequate, and the percentage of variance explained by the two components were about 90%, which confirms the correct statistical functioning.

Regarding the evaluation of the measurement mode, according to Hair *et al.* (2013), in order to obtain a correct reliability indicator in reflective measurement models, the standardized loadings of the variables should be greater than 0.7 and significant (value t > 1.96) (**Table 4**). However, half of and "Facilitating Conditions" items and only one item of the "Performance Expectancy" standardized loadings, when rounded up, remain inferior to 0.7. In that case, the variable based on Chin (1998) was kept because the standardized loading rule of 0.7 is flexible, particularly when the indicators contribute to the validity of the factor content.

Then, the reliability of the collected data is analyzed through Cronbach's alpha. Cronbach's alpha is a measure of internal consistency that indicates how closely related a set of items are as a group. In this case, the 16 items illustrated in **Table 1** and **Table 4** have been tested, as well as Cronbach's alphas as it can be observed as a result in **Table 5**, where all items display a Cronbach's Alpha greater than 0.7, confirming that the construct reliability was essentially adequate. For clarity purposes, a "high" value for alpha does not imply that the measure is unidimensional; a factor analysis would be needed to determine such a thing.

Finally, the average variance extracted is considered. In statistics, average variance extracted is a measure of the amount of variance that is captured by a construct in relation to the amount of variance due to measurement error (Fornell & Larcker, 1981). In this research, it is worth mentioning that every scale, excluding "facilitating conditions", showed an average variance extracted (AVE) greater than or equal to 0.5; the convergent validity criterion was thus almost perfectly met. In most cases, the square root of the AVE was greater than the correlations between constructs, proving that the discriminant validity criterion was also met (Roldán & Sánchez-Franco, 2012) (**Table 5**). The HTMT values were correct in all cases (<0.9) (Gold, Malhotra, & Segars, 2001) (**Table 7**).

Table 6 KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		,802
Bartlett's Test of Sphericity	Approx. Chi-Square	242,185
	df	10
	Sig.	,000

Construct	IU	PE	EE	SI	FC
Intention to use (IU)	**0,815**				
Performance Expectancy (PE)	0,629*	**0,795**			
Effort Expectancy (EE)	0,282*	0,185*	**0,821**		
Social Influence (SI)	0,439*	0,490*	0,149	**0,838**	
Facilitating Conditions (FC)	0,392*	0,341*	0,372*	0,157	**0,65**

Table 7 Divergent Validity: Bold data on the diagonal are the square root of the AVE. Data located below the diagonal are the correlations between the constructs.

Explanatory Model of the Intention to Use Blockchain

In order to either accept or reject our hypotheses, results from the Pearson will be interpreted in this section. Indeed, the Pearson as illustrated in **Table 8** reveals important and significant relationships. Since Spearman refers to a correlation analysis that focuses on the strength of the relationship between two or more variables, the results highlighted in **bold** represent significant correlations at the 0.01 level. On the first column on the table, the relationship between the dependent variable "intention to use" and the four independent variables can be observed, and it reveals that each correlation is significant at the 0.01 level. Moreover, Pearson test was executed one-tail since the hypotheses were directional. Based on those results, the first 4 hypotheses of this research can therefore be confirmed, namely performance expectancy regarding using the blockchain technology positively and strongly does influence the intention to use it **(H1)**, effort expectancy regarding using the blockchain positively and strongly influences the intention to use it **(H2),** social influence regarding using the blockchain positively and strongly does influence the intention to use it **(H3)**, as well as facilitating conditions for using the blockchain positively and strongly influences the intention to use it **(H4).** Furthermore, it is worth mentioning that performance expectancy displays the highest degree of correlation with the intention to use the blockchain technology with a coefficient of ,781, followed respectively by social influence (,608), effort expectancy (,490) and facilitating conditions (,460). These results also indicate us that the UTAUT model remains relevant to use today and that, despite its disruptive characteristics, the blockchain remains a technology comparable to others that also have been research through such models such as: the "smart" phones, digital wallet/ currency and mobile commerce/ banking.

Table 8 Pearson

Pearson		
		Intention to Use
Intention to Use	Correlation Coefficient	1
	Sig. (1-tailed)	.
	N	110
Performance Expectancy	Correlation Coefficient	**,781**
	Sig. (1-tailed)	,000
	N	110
Effort Expectancy	Correlation Coefficient	**,490**
	Sig. (1-tailed)	,000
	N	110
Social Influence	Correlation Coefficient	**,608**
	Sig. (1-tailed)	,000
	N	110

Facilitating Conditions	Correlation Coefficient	**,460**
	Sig. (1-tailed)	,000
	N	110

In order to either accept or reject our hypotheses, results from the hierarchical multiple regression will now be interpreted in this section. A hierarchical linear regression is a special form of a multiple linear regression analysis in which more variables are added to the model in separate steps ironically called “blocks.” This is often implemented to statistically “control” for certain variables, to see whether adding variables significantly improves a model’s ability to predict the criterion variable and/or to investigate a moderating effect of a variable. In this research, the first “block” or model solely include the descriptive variable “awareness” (whether or not respondents knew about the technology before responding to the questionnaire), the second model adds up the “self-labelling” descriptive variable (whether respondents subjectively consider themselves as “non-adopters” or “blockchain enthusiasts” before responding to questions related to UTAUT model), the third “block” include gender alongside “self-labelling” and “awareness”, the fourth one adds the age, the fifth one carries the education level, the sixth model introduces the monthly salary of the respondents while the seventh and final model consists of both all independent variables from the UTAUT model and descriptive variables used to “control” how they potential moderate the influence those independent variables can have on the intention to use the blockchain technology as described in **Figure 1**.

Moreover, the results related to the hierarchical multiple regression is threefold namely through the r-square, ANOVA and the contribution standardized. Firstly, the R-square is known for being is a measure of how well variables of the model explain some phenomenon. As a result, through model 7 that refers to the model used in this research (**Figure 1**), it has been proven that our model explains 72.6% of the variance in the dependent variable, namely the intention to use the blockchain technology since the R-square result is statistically significant (**Table 9**). Additionally, it is worth mentioning that models 1 & 2 display a significant F-change. A significant F-change means that the variables added in a “block” or model significantly improved the prediction. In this case study, we can therefore argue that both “awareness” and “self-labelling” are descriptive variables that have a significant moderator effect on the relationship of the independent variables and the intention to use the blockchain technology.

Table 9 R-Square from Hierarchical Multiple Regression

Model Summary					
Model	**R**	**R-Square**	**R Change**	**F Change**	**Sig. F Change**
1	,289	,083	,083	9,833	,002
2	,456	,208	,124	16,771	,000
3	,465	,216	,008	1,143	,288
4	,466	,217	,001	,096	,758
5	,467	,218	,002	,216	,643
6	,470	,221	,002	,324	,570
7	,852	,726	,505	45,691	,000

Secondly, an analysis of variance (ANOVA) is a collection of statistical models and their associated estimation procedures used to analyze the differences among group means in a sample, thus its null hypothesis stating that there is no difference in means. Eventually, ANOVA has been proven to be statically significant, as shown in **Table 10** allowing us to reject that null hypothesis.

Thirdly, the contribution standardized is a metric that describes how each independent variable, in its standardized form, contribute to a depend variable. Because the sign of a regression coefficient tells whether there is a positive or negative correlation between each independent variable the dependent variable. A positive coefficient indicates that as the value of the independent variable increases, the mean of the dependent variable also tends to increase. In this case, as a result, in this research, both the performance expectancy and the social influence variables appear to be statistically significant with the PE index increasing by value of 1, for every unit of change for PE, a ,591 change in the intention to use the blockchain will be seen. The same goes for the social influence variable with a ,184 change instead as illustrated in **Table 11**.

Table 10 ANOVA Table

Model		**Sums of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	**Regression**	20,483	1	20,483	9,833	,002
2	**Regression**	50,966	2	25,483	14,020	,000
3	**Regression**	53,041	3	17,680	9,740	,000
4	**Regression**	53,216	4	13,304	7,267	,000
5	**Regression**	53,614	5	10,723	5,813	,000
6	**Regression**	54,216	6	9,036	4,867	,000
7	**Regression**	178,261	10	17,826	26,264	,000

Table 11 Coefficients

Coefficients					
	Unstandardized B	**Coefficients Std. Error**	**Standardized Coefficients Beta**	**t**	**Sig.**
(Constant)	1,824	,801		2,278	,025
Awareness	**-,399**	,101	-,215	-3,962	,000
Self-Labelling	**-,403**	,185	-,125	-2,181	,032
Gender	-,208	,164	-,069	-1,262	,210
Demographic group	,035	,158	,014	,219	,827
Education level	,057	,120	,029	,474	,636
Salary	,013	,055	,015	,240	,810
Performance Expectancy	**,591**	,084	,535	7,053	,000
Effort Expectancy	,096	,078	,082	1,225	,223
Social Influence	**,184**	,079	,168	2,326	,022
Facilitating Conditions	,119	,088	,090	1,359	,177

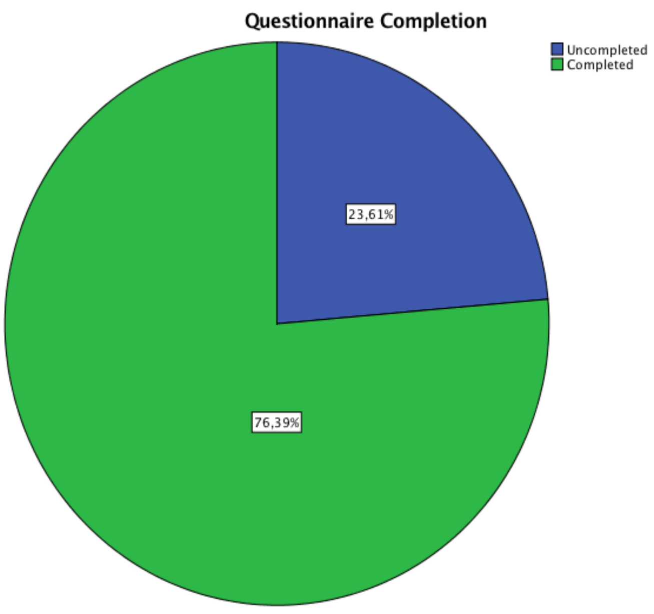
To conclude, results provided by the hierarchical multiple regression reassure the fact that altogether, through a statistically significant R-Square of model 7, 72.6% of the variance in the intention to use the blockchain is explained in our models by all independent and descriptive variables, notably with the significant help of both “awareness” and “self-labelling”.

Discussion & Conclusion

This research highlights some key findings. First, the sample has overall provided a positive response to the intention to use the blockchain technology since its arithmetic mean is 4.6 on a scale from 1 (strongly disagree) to 7 (strongly agree), which can be translated into “somewhat agree” on the willingness to use the technology. Secondly, as a result from the Pearson correlation test, each and every variable displays a significant and positive correlation confirming **H1**, **H2**, **H3** and **H4**, where the highest correlated variable is the performance expectancy, followed respectively by social influence, facilitating conditions and effort expectancy. Those results clearly demonstrate that the UTAUT model remains, once again, an accurate and valid source to describe the intention to use the blockchain technology and potentially other upcoming technologies. Moreover, in this research, the social influence seems to have the second strongest correlation to the intention to use which supports Rogers’ (1995) view on the influence of people surrounding individuals. Indeed, according to him, the first adopter of an innovation discusses it with other members of the system, and each of these adopters pass the new idea along to other peers, which is currently the case within the blockchain community through the creation of numerous crypto-currencies and distinct implementations in several industries such as banking, supply chain and education for instance. Secondly, a hierarchical multiple regression analysis has been executed in order to provide us information on whether or not, other descriptive variables have been entered into the regression equation in order to “control” how they may influence the impact the independent variables have on the intention to use, as moderators. Results suggest that only descriptive variables such as “awareness” and “self-labelling” have displayed a significant F-change. They, therefore, when added in a “block” in the regression, significantly improved the predictive power of all independent variables.

Naturally, this research has encountered several issues and limitations. Firstly, a technical issue occurred through the incapacity to execute a PLS-SEM test, which is mostly used in academia when UTAUT model is being tested in a research, highlighting its potential efficiency and convenience. Secondly, it has been surprisingly discovered that the completion of the questions was challenged since around 24% of the questionnaires were not fully completed (**Pie Chart 1**), eventually influencing the quality of the analysis, such as in the variation of the number of respondents in each variables when analyzing the strength and direction of the relationship with the intention of use in **Table 8**. Indeed, it can be argued that those missing values could potential play a great role on the abnormality of the distribution since Li *et al.* (2012) argue that diagnostic checking in regression relationships nevertheless is important and, although linear regression still is appropriate in many situations, there are many other pitfalls that may affect the quality of the interpretations and conclusions drawn from poorly fitted models, such as the incapacity to reject the regression related hypotheses for both the effort expectancy and facilitating conditions for instance. Thirdly, it would also be recommended to use the same control variables as control variables, therefore including them in the analysis in order to determine how much they can influence the impact of the performance expectancy, effort expectancy, social influence and the facilitating conditions on the intention to use the blockchain technology. Lastly, despite being an insightful descriptive variable, a better way to measure how can respondents self-labelled themselves needs to be used. Indeed, in this research, the opportunity to self-labelling themselves was given to respondents in a very subjective and unmeasurable way. Thus, despite the encouraging results presented in the previous paragraph, a few several limitations have prevented this research to reach its true potential. It is for this reason that recommendations are giving to contribute further into the field.

Nonetheless, those findings encourage further future research. First, and in relation to the last limitation mentioned in the previous paragraph, once a convenient way is found to measure self-labelling as a descriptive variable and in order to have a clearer picture, it would be recommended to use that latter, alongside with other control variables, as control variables to have sufficient number of both “non-adopters” and “blockchain enthusiasts” in one sample so that, now that the relationship between the independent and dependent variables has been proven to be positively and strongly related to one another, both groups could then be compared one another with relevant and valid data on the difference they manifest towards the performance expectancy, effort expectancy, social influence and facilitating conditions (through a fully completed questionnaire rate). Furthermore,



Pie Chart 1 Questionnaire Completion

despite the UTAUT already being widely used and insightful, other theory can also be explored since it can be argued that the stages by which a person adopts an innovation, other than decision to adopt (or reject) the innovation as studied in this research, such as: the awareness of the need for an innovation, initial use of the innovation to test it, and continued use of the innovation. It would therefore be recommended and insightful to replicate such research in different locations while investigating those particular variables.

Finally, based on its results, this research involves practical implications. First, since both the performance expectancy and social influence are crucial variables highly correlated to the intention to use, it would be advised to combine both by advocating the advantages and added-value of the blockchain technology. Indeed, in order to gain further exposure through the power of word of mouth and bring more awareness towards the technology, it is recommended that blockchain entrepreneurs incentivize their early adopters to spread the word, notably through one's product/service performance features powered by the blockchain technology as a way to optimize . For instance, blockchain entrepreneurs should provide a convenient advantage such as a discount to both its early adopters and its newly acquired users. Secondly, blockchain entrepreneurs should raise awareness among the youth through given lectures and speeches in universities and conference or through YouTube videos, podcasts, specific magazine and through social medias by creating appealing content to that particular since they might be more inclined to use such innovative technology since a majority of them can be considered as "digital natives", and as such, with the power of social media, the social influence variable can eventually have a greater influence on the variance to the intention to use when compared with the performance expectancy. In a nutshell, it is believed that such marketing campaign will benefit both blockchain entrepreneurs and society at large through the diffusion of the blockchain technology.

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