



**CATÓLICA  
LISBON**  
BUSINESS & ECONOMICS

# **Blockchain Technology: A Technology Acceptance Model (TAM) Analysis**

Written by

**Alexander Kern**

Student Number: 152116168

Under the supervision of

**Prof. Paulo Romeiro**

Dissertation submitted in partial fulfillment of requirements for the MSc in  
Business, at CATÓLICA-LISBON - School of Business & Economics

**January 2018**

## **ABSTRACT**

**Title:** Blockchain Technology: A Technology Acceptance Model (TAM) Analysis

**Author:** Alexander Kern

As of today, Blockchain is an innovative distributed ledger technology enabling the exchange of value online without the need of intermediaries such as banks or players of the shared economy. The technology provides a decentralized and trustless network, secured by cryptography and consensus mechanisms.

The study attempted to assess the current 'Level of Knowledge' about the up-and-coming Blockchain technology throughout society, which is considered to be fundamental in order to unfold full socio-economic potential. Based on a modified version of the Technology Acceptance Model (TAM) by Davis (1989) the study sought to define relationships between self-reported variables such as 'Perceived Ease of Use', 'Perceived Usefulness' and 'Perceived Risk', ultimately predicting the 'Intention to Use' of Blockchain. An online questionnaire was designed and shared across a convenience sample population, comprised by young students and professionals.

The results reveal that about two thirds of the sample population is non-aware of the topic at hand. The findings affirm overall significance and appropriateness of the tested constructs within the conceptual framework. A system will be accepted, if it is perceived as trustworthy, convenient and useful. 'Perceived Risk' was the most significant determinant in predicting intended use. Regression analysis revealed significant relationships among all the variables used.

Managerial as well as academic implications about the outcomes of this study have been formulated.

It should be noted, that due to the nature of TAM and the convenience sample, general conclusions about society's perception are limited.

## SUMÁRIO

**Title:** Blockchain Technology: A Technology Acceptance Model (TAM) Analysis

**Author:** Alexander Kern

Atualmente o Blockchain, ou “protocolo de segurança” é uma tecnologia inovadora que garante a partilha de valor online sem intermédio de terceiros. Por outras palavras, a tecnologia garante uma rede descentralizada e segura, assegurada pela criptografia e outros mecanismos consensuais, criando uma alternativa à confiança em bancos e outros players que atuam sob a economia partilhada.

O estudo em causa tenta avaliar o atual “Nível de Conhecimento” na sociedade relativamente à tecnologia, considerado como um ponto fundamental para revelar todo o seu potencial socioeconómico. O mesmo, é baseado numa versão modificada do modelo Technology Acceptance Model (TAM), proposto por Davis (1989), que procura definir relações entre variáveis previamente definidas como: ‘Facilidade de Utilização Percebida’, ‘Utilidade Percebida’ e ‘Risco Percebido’ que preveem a intenção de uso do Blockchain. Isto é, afirmar-se-á que um sistema é aceite caso seja visto como seguro, conveniente e útil.

Um questionário relativo ao tópico foi partilhado entre uma amostra por conveniência, composta por jovens estudantes e profissionais. Os resultados revelam que cerca de dois terços dos indivíduos que compõem a amostra não estão cientes do tópico em causa.

Identificou-se que a variável ‘Risco Percebido’ é aquela que significativamente melhor determina a intenção de uso, sendo que, a análise de regressão revelou relações significativas entre todas as variáveis utilizadas.

Implicações académicas e de gestão foram formuladas após a análise dos resultados. Contudo, devido à natureza da TAM e à amostra por conveniência as conclusões gerais sobre a percepção da sociedade relativamente ao Blockchain são limitadas.

## **ACKNOWLEDGEMENTS**

First and foremost, my gratitude goes to my beloved family, who provided me with the best opportunities and the finest education and have always taught me to be passionate and ambitious, regardless from what I chose to do in life. Their optimism and boundless encouragement were far-reaching and decisive not only for the completion of this Dissertation, but also by accompanying and supporting me to become the person I am today. It fills me with joy and pride and motivates me every day to have such a great brother, parents and great-parents, who I can always count on.

Moreover, I would like to express my earnest gratitude to my thesis supervisor, Professor Paulo Romeiro, for his guidance and feedback, but most of all for his patience, flexibility and encouragement, which were crucial for completing this thesis.

I am also very grateful to my wonderful friends, whether in Lisbon, Germany or elsewhere in the world, who always demonstrate enormous support and constant availability, sharing their valuable time, knowledge and laughter with me. They support me unconditionally and inspire me to set my goals high and don't settle for anything less than what I am capable of. In regards to this work and my time in Lisbon, I would like to express my outmost appreciation to Mariana Dias, Gregory Neff, Farid Kreh, Benjamin Berggold and Felix Otto Braun.

## TABLE OF CONTENTS

ABSTRACT.....	II
SUMÁRIO.....	III
ACKNOWLEDGEMENTS.....	IV
TABLE OF CONTENTS.....	V
TABLE OF FIGURES.....	VII
LIST OF ACRONYMS.....	IX
<b>CHAPTER 1: BACKGROUND &amp; INTRODUCTION.....</b>	<b>1</b>
1.1 BACKGROUND.....	1
1.2 INTRODUCTION.....	2
1.3 PROBLEM STATEMENT.....	3
1.4 RELEVANCE.....	3
1.5 RESEARCH METHODS.....	4
1.6 DISSERTATION OUTLINE.....	5
<b>CHAPTER 2: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK.....</b>	<b>6</b>
2.1 BLOCKCHAIN TECHNOLOGY: DEFINITION AND KEY CHARACTERISTICS.....	6
2.1.1 EXCHANGING VALUE.....	6
2.1.2 DATA MINING.....	8
2.1.3 SMART CONTRACTS.....	9
2.1.4 TYPES OF BLOCKCHAIN.....	9
2.2 TECHNOLOGY ACCEPTANCE MODEL (TAM).....	10
2.2.1 PERCEIVED USEFULNESS (PU).....	11
2.2.2 PERCEIVED EASE OF USE (PEU).....	12
2.2.3 TAM LIMITATIONS & EXTENSIONS.....	13
2.3 EXTENDED TAM: THE E-COMMERCE ACCEPTANCE MODEL.....	14
2.3.1 PERCEIVED RISK (PR).....	15
2.3.2 LEVEL OF KNOWLEDGE (LK).....	17
2.4 MODIFIED TAM: BLOCKCHAIN ACCEPTANCE MODEL.....	18
2.5 CONCLUSION LITERATURE REVIEW.....	19
<b>CHAPTER 3: METHODOLOGY.....</b>	<b>21</b>
3.1 REVIEW OF CONCEPTUAL MODEL AND RESEARCH APPROACH.....	21
3.2 DATA COLLECTION.....	21
3.3 CONSTRUCT MEASUREMENTS.....	22
3.4 DATA ANALYSIS.....	23
<b>CHAPTER 4: RESULTS AND DISCUSSION.....</b>	<b>25</b>
4.1 QUALITATIVE RESEARCH.....	25
4.2 QUANTITATIVE RESEARCH.....	26
4.2.1 SAMPLE CHARACTERIZATION.....	26
4.2.2 RELIABILITY OF CONSTRUCTS.....	28
4.2.3 DESCRIPTIVE STATISTICS FOR EACH VARIABLE.....	29
4.2.4 HYPOTHESES TESTING.....	30
THE EFFECT OF LK ON PR.....	30

<u>THE EFFECT OF PR ON IU</u> .....	31
<u>THE EFFECT OF LK ON IU</u> .....	32
<u>THE EFFECT OF LK ON PEU</u> .....	32
<u>THE EFFECT OF PEU ON IU</u> .....	33
<u>THE EFFECT OF LK ON PU</u> .....	34
<u>THE EFFECT OF PU ON IU</u> .....	35
<u>THE EFFECT OF PEU ON PU</u> .....	36
4.2.5 <u>THE EFFECT OF EDUCATION</u> .....	38
<b>4.3 DISCUSSION</b> .....	39
<b>CHAPTER 5: CONCLUSIONS AND LIMITATIONS</b> .....	<b>42</b>
<b>5.1 CONCLUSIONS</b> .....	42
<b>5.2 MANAGERIAL &amp; ACADEMIC IMPLICATIONS</b> .....	42
5.2.1 <u>MANAGERIAL IMPLICATIONS</u> .....	42
5.2.2 <u>ACADEMIC IMPLICATIONS</u> .....	43
<b>5.3 LIMITATIONS AND FUTURE RESEARCH</b> .....	44
5.3.1 <u>LIMITATIONS</u> .....	44
5.3.2 <u>FUTURE RESEARCH</u> .....	44
<b>REFERENCE LIST</b> .....	<b>I</b>
<b>APPENDICES</b> .....	<b>V</b>
<b>APPENDIX 1: SURVEY DESIGN</b> .....	V
<b>APPENDIX 2: SPSS OUTPUT – DEMOGRAPHIC STATISTICS</b> .....	XII
<b>APPENDIX 3: SPSS OUTPUT – LEVEL OF KNOWLEDGE DESCRIPTIVE STATISTICS</b> .....	XIII
<b>APPENDIX 4: SPSS OUTPUT – RELIABILITY ANALYSES</b> .....	XIV
<b>APPENDIX 7: SPSS OUTPUT – THE EFFECT OF PR ON IU</b> .....	XVII
<b>APPENDIX 8: SPSS OUTPUT – THE EFFECT OF LK ON IU</b> .....	XVIII
<b>APPENDIX 9: SPSS OUTPUT – THE EFFECT OF LK ON PEU</b> .....	XIX
<b>APPENDIX 10: SPSS OUTPUT – THE EFFECT OF PEU ON IU</b> .....	XX
<b>APPENDIX 12: SPSS OUTPUT – THE EFFECT OF PU ON IU</b> .....	XXI
<b>APPENDIX 13: SPSS OUTPUT – THE EFFECT OF PEU ON PU</b> .....	XXII
<b>APPENDIX 14: SPSS OUTPUT – THE EFFECT OF INFORMATION ON EACH VARIABLE</b> .....	XXIII

## TABLE OF FIGURES

<b>Figure 1:</b> Conceptual Model.....	4
<b>Figure 2:</b> Technological Design of a common Blockchain.....	7
<b>Figure 3:</b> Blockchain Transaction Cycle (Source: <a href="https://blockgeeks.com/">https://blockgeeks.com/</a> ).....	8
<b>Figure 4:</b> TAM by Davis (1989) .....	11
<b>Figure 5:</b> Extended TAM: The e-Commere Acceptance Model by Pavlou (2003) .....	14
<b>Figure 6:</b> Modified TAM - Blockchain Acceptance Model.....	18
<b>Figure 7:</b> Proposed constructs, relevant literature source and number of scale items .....	23
<b>Figure 8:</b> Combined Multiple Mediation Model .....	24
<b>Figure 9:</b> Blockchain Matrix - Key Characteristics .....	25
<b>Figure 10:</b> Gender Distribution .....	26
<b>Figure 11:</b> Age Distribution .....	26
<b>Figure 12:</b> Employment Status.....	27
<b>Figure 13:</b> Education Level.....	27
<b>Figure 14:</b> Level of Knowledge - Descriptive Statistics .....	28
<b>Figure 15:</b> Reliability Analysis .....	29
<b>Figure 16:</b> Descriptive Statistics (PEU, PU, PR, IU).....	29
<b>Figure 17:</b> Effect of LK on PR.....	30
<b>Figure 18:</b> Effect LK on IU through PR.....	31
<b>Figure 19:</b> Effect of LK on IU.....	32
<b>Figure 20:</b> Effect of LK on PEU .....	33
<b>Figure 21:</b> Effect of LK on IU through PEU.....	33
<b>Figure 22:</b> Effect of LK on PU.....	34
<b>Figure 23:</b> Effect of LK on IU through PU .....	35
<b>Figure 24:</b> Effect of LK on PU through PEU.....	36
<b>Figure 25:</b> Effect Sizes and Directions.....	37

**TABLE OF TABLES**

**Table 1:** Variables ..... 5

**Table 2:** Hypotheses ..... 19

**Table 3:** Hypothesis Testing..... 38

**Table 4:** Mediation Effects ..... 38

**Table 5:** Effects of Information on each Variable ..... 39

## LIST OF ACRONYMS

<b>IoT</b>	Internet of Things
<b>HTML</b>	Hypertext Markup Language
<b>LK</b>	Level of Knowledge
<b>PEU</b>	Perceived Ease of Use
<b>PU</b>	Perceived Usefulness
<b>PR</b>	Perceived Risk
<b>IU</b>	Intention to Use
<b>RQ</b>	Research Question
<b>DLT</b>	Distributed Ledger Technology
<b>ATU</b>	Attitude towards Using
<b>ASU</b>	Actual System Use
<b>PKI</b>	Public Key Infrastructure
<b>IV</b>	Independent Variable
<b>DV</b>	Dependent Variable
<b>MTP</b>	Matching Person & Technology
<b>HMSAM</b>	Hedonic Motivation System Adoption Model

## **CHAPTER 1: BACKGROUND & INTRODUCTION**

### **1.1 Background**

This work is related to the up-and-coming topic of Blockchain technology, originally developed as the accounting method for Bitcoin by Satoshi Nakamoto, (2008). Since its introduction, the underlying technology has been in the focus of several studies and journals, while also experiencing rapidly increasing media coverage resulting in an euphoria among technology aficionados. The Association of Computing Machinery stated that “Blockchain is expected to revolutionize industry and commerce and drive economic change on a global scale because it is immutable, transparent, and redefines trust, enabling secure, fast, trustworthy, and transparent solutions” (Underwood, 2016).

In order to better understand the magnitude of the underlying technology, supporting infamous applications such as Bitcoin, we have to go one step back before focusing on Blockchain. The Internet as we know it right now can be described as the Internet of Information, allowing us to communicate, collaborate and connect online. Triggering the rise of emerging dot-com companies, changing industries and businesses in a global scale, the Internet had an undoubted impact on most of our lives. Even products become increasingly ‘smart’ by being connected to the Internet and continuously exchanging data with third parties. “The Internet-of-Things (IoT) revolves around interconnected devices, systems and services within the existing Internet infrastructure.” (Ngyuen & De Cremer, 2016). While all of this offers a lot of opportunities, it also carries, among other things, enormous risks concerning users privacy and security. “The potential consequences of successful attacks could impact human lives and safety, and cause death and destruction - directly or indirectly. Privacy violations that let criminals exploit information about potential victims can also constitute threats to safety” (Lindqvist & Neumann, 2017). Although the Internet revolutionized whole industries and the way we live our lives, it becomes clear that there’s a need of improvement in terms of security, privacy and economic value distribution. Using current technology in order to exchange money or other assets, confronts us with an accounting problem of record-keeping, resulting in the need of relying on third parties. As the economist Don Tapscott describes: “The information-centric medium of the web, which after all is based on an interlinked page model and publishing language (HTML), was never designed to handle the exchange of actual value”. Powerful intermediaries and platforms like credit card companies, PayPal or even AirBnB establish trust and connect parties, which

naturally comes at an additional cost. “The cost of mediation increases transaction costs, limiting the minimum practical transaction size and cutting off the possibility for small casual transactions, and there is a broader cost in the loss of ability to make non-reversible payments for nonreversible services” (Nakamoto, 2008). This not only means that value is lost in transaction fees, long waiting times and limited trust, you also pay with your personal information and online identity which is collected and often monetized by those intermediaries. Current technology and online infrastructure cannot store, move or transact value without influential intermediaries. And that is what Blockchain can change for the better.

Don Tapscott concludes, “the underlying technology of Blockchains might actually represent a second era of the internet. For the last 40 years we’ve had the Internet of Information; now, with Blockchains, we’re getting the Internet of Value” (MacIver, 2016). Blockchain can be described as a public ledger which everyone can access, but which no single person or central authority controls. “It allows for companies and individuals to collaborate with an unprecedented degree of trust and transparency. It is cryptographically secure, but fundamentally open” (Tapscott & Tapscott, 2016). Therefore the technology promises enormous socio-economic potential, meaning that “there’s less potential for fraud and corruption, trade becomes more efficient and less costly, government becomes more effective, and local technology hubs can form to build out the infrastructure and export the knowledge gained” (Gupta & Knight, 2017).

The technology, as described before, already caught the attention of companies, governments and other institutions. But while industries and governance are constantly working towards possible Blockchain implementations, it’s not sure and well researched how the rest of society perceives it. Current research focuses mainly on economic potential, possible implementation, legislative barriers and social impact, but misses to represent perception, knowledge and attitude of society towards Blockchain. While the technology promises extreme potential to improve privacy, transparency and access to economic prosperity to its users, the literature fails to get profound insights about potential users who are the foundation of a decentralized and beneficial Blockchain network. So the question arises: Is society ready for Blockchain?

## **1.2 Introduction**

This research provides a quantitative approach, based on the Technology Acceptance Model (TAM) by Davis (1989), in order to fill the research gap described above and better understand public interest, current state of knowledge and perceived value of society towards

Blockchain. Despite the increasing euphoria around the technology, mostly in an economic context, it is not clear how prepared people are. Since the technology is based on public consensus, the integration of society in such a socially influential technological breakthrough is crucial to unfold its full potential. “With Blockchain, for the first time, we have a new digital medium for value where anyone can access anything of value - stocks, bonds, money, digital property, titles, deeds - and even things like identity and votes can be moved, stored and managed securely and privately” (Shin, 2016). However it seems that it is really hard for most people to grasp the significance of it.

### **1.3 Problem Statement**

The problem this thesis strives to understand is how ready or prepared society currently is about the expected Blockchain revolution. By measuring the current Level of Knowledge (LK) among potential end-users and testing self-reported factors such as Perceived Ease of Use (PEU), Perceived Usefulness (PU), Perceived Risk (PR) and the Intention to Use (IU) Blockchain, a general, societal picture of awareness and compliance about this topic will be drawn. The perception of society will be crucial in terms how the technology will be developed and implemented. A quantitative model will generate insights.

This problem statement it substantiates itself in the following research questions:

**RQ1:** “What is Blockchain Technology? What are its key characteristics?”

**RQ2:** “What is the current level of knowledge about Blockchain among potential end-users?”

**RQ3:** “How does the level of knowledge influence the perception on Blockchain?”

**RQ4:** “What are the main drivers on a person’s likelihood to use Blockchain?”

### **1.4 Relevance**

While a lot of research has been done on potential implementations of this technology and its socio-economic effects, the current literature lacks the perception of society on this topic. The paper aims to fill this gap by quantitatively analyzing the public perception and state of knowledge about Blockchain technology. Since the technology is based on public consensus and holds immense potential for the economical prosperity of each of us, it is crucial that

more people are involved in this development process in order to unfold the full potential and don't leave it in the hands of big companies and governments to privatize the technology. Future strategies of how to implement the technology in the best possible way should be based on aspects benefitting society, in this case the user or customer of a product or service. User- or customer-oriented strategies demand valuable insights about the community of potential users. This research will help to better understand the people who will be affected by this technological innovation and how to deal with them.

### 1.5 Research Methods

In order to answer the research questions, both primary and secondary data will be used. Secondary data will help to draw a picture about the most important aspects of Blockchain. Current literature provides profound information on these topics.

Regarding public awareness and perception towards Blockchain, a online survey has been conducted in order to gain primary insights into potential users of the technology.

The questionnaires will be structured and analyzed based on the TAM (F.D. Davis, 1989). The model predicts the user acceptance of end-user applications by specifying relationships among perceived usability and attitudinal constructs that mediate the influence of external variables on usage behavior. When users are presented with a new technology, a number of factors influence their decision of how they will use the technology. The following diagram shows structure and relationships between different factors (Fig. 1), also a brief description of each variable is provided on the next page (Table 1).

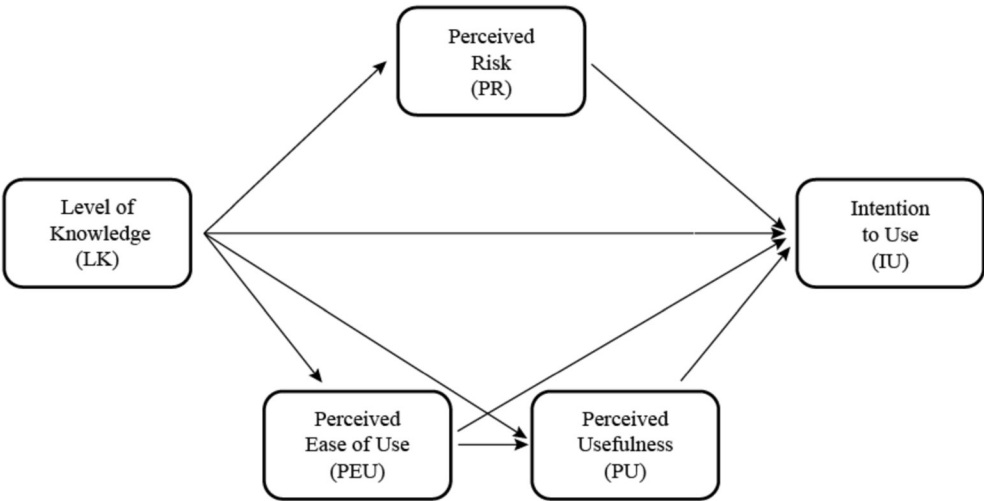


Figure 1: Conceptual Model

<b>Variable</b>	<b>Definition</b>
<b>Level of Knowledge (LK)</b>	A scale measuring the current state of awareness about Blockchain
<b>Perceived Ease of Use (PEU)</b>	The degree to which a person believes that using Blockchain would be convenient
<b>Perceived Usefulness (PU)</b>	The degree to which a person believes that using Blockchain would enhance their lives
<b>Perceived Risk (PR)</b>	The degree to which a person believes that using Blockchain would involve risk
<b>Intention to Use (IU)</b>	Describes a person's subjective probability to engage in the adoption of Blockchain

**Table 1:** Variables

## 1.6 Dissertation Outline

The dissertation outline aims to provide guidance of each following chapter by giving a brief description about the contents.

The second chapter is focusing on findings from the literature review, accompanying the research approach and conceptual framework of this work. Besides providing a explanation of Blockchain technology, the literature review includes definitions of the selected variables and describes the relationships between predicting and outcome factors. Several hypothesis have been derived that will guide the study during the empirical study. Based on the TAM by Davis (1989), a distinct methodology is introduced in order to answer to the hypothesis at hand.

Afterwards the Methodology Chapter will provide a detailed description of the procedure used in order to answer the RQ's and testing the proposed hypotheses.

The fourth chapter will make an in-depth analysis of the statistically relevant results obtained from the previous collected primary data as well as summarizing the key findings of the literature in order to answer RQ1. The Chapter includes detailed presentation of empirical results, followed by the hypotheses testing. The execution of the conceptual model, as described before, is a first step towards the inclusion of society's perception into the current scientific environment.

The final chapter will conclude the work in terms of main findings as well as managerial implementations, limitations and recommendations for future researchers. Analyzing gained insights into society's perception of Blockchain will show potential for future studies, while also considering limitations of this paper. Combining the TAM with Blockchain can be the foundation of future research in this field of study, aiming to bring society in line with fast moving technological progress.

## **CHAPTER 2: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK**

Based on the current state of research, the literature review provides the technological background of Blockchain and therefore the foundation of this paper. The chapter aims to introduce the reader into the area of Blockchain and therefore give an idea of the magnitude and potential impact of the technology. This is followed by a representation of the TAM and the modified version of the conceptual model used for this study.

The chapter aims to present a theoretical framework and qualitative basis on the topics related to the main research questions and study purpose. The research was conducted by using secondary data, such as current relevant studies, academic journals and scientific articles.

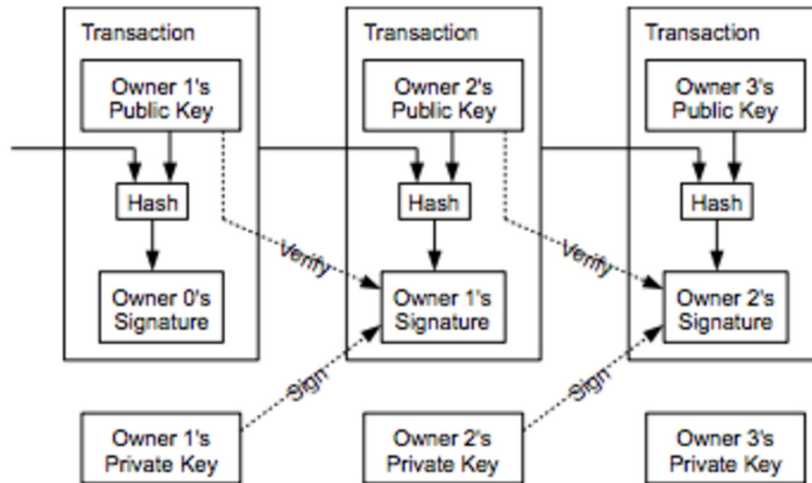
### **2.1 Blockchain Technology: Definition and Key Characteristics**

The Blockchain technology is a “decentralized transaction and data management technology” (Yli-Huumo, Ko, Choi, Park, & Smolander, 2016) that can be used to create “a tamper-proof, cryptographically-secure online ledger [...] used to verify transactions securely and directly, on a peer-to-peer and decentralized basis, without the need for a middleman like a bank or financial institution” (Heires, 2016).

Firstly, a digital network is created and genuine members are invited to the network. The permissions allowing participants to write or read will be provided according to the rules of the Blockchain network (Siba, Prakash, & Prakash, 2017). Currently, “the most important and far-reaching Blockchains are based on Satoshi’s Bitcoin model” (Tapscott & Tapscott, 2016). Blockchain is the elementary technology underlying cryptocurrencies such as Bitcoin or Ether, Ripple or IOTA. Although, the design of these models don’t necessarily include, or are limited to the use of cryptocurrencies (Tapscott & Tapscott, 2016). Therefore, it is best described as a Distributed Ledger Technology (DLT), which is “essentially an asset database that can be shared across a network of multiple sites, geographies or institutions. [...] The assets can be financial, legal, physical or electronic” (Hancock & Vaizey, 2016).

#### 2.1.1 Exchanging Value

“A transaction is created in Blockchain, when any digital asset is transferred. A block has been formed with multiple transactions and it is secured by hash codes. The transaction entry is made ineradicable by hashing the transactions with the previous blocks, thus chaining them together” (Siba et al., 2017). Figure 2 illustrates this process of linking single blocks of information together and therefore creating a dependency between them.



**Figure 2:** Technological Design of a common Blockchain

A typical Blockchain consists of data blocks containing records of transactions that are linked through consecutive hash numbers, and therefore creating a dependency or chain, generated from the content of the previous block plus a random part (Aste, Tasca, & Centre, 2017).

The records of these actions are permanently shared or distributed across the network's participants. For further security and traceability, time stamps, digital signatures, public and private keys are embedded in each block. "All participants within a network can have their own identical copy of the ledger. Any changes to the ledger are reflected in all copies in minutes, or in some cases, seconds" (Hancock & Vaizey, 2016). This depends on the 'heartbeat' of the network. For instance the Bitcoin Blockchain updates every ten minutes automatically, meaning that all ledger copies of each user must be in sync. If unauthorized information is implemented or extracted in one of the blocks the network automatically compares this block with the copies of the others. Tampered blocks will be rejected by the network and replaced by a copy of approved by the consensus.

On the following page, Figure 3 demonstrates a full transaction cycle, highlighting the most important steps.

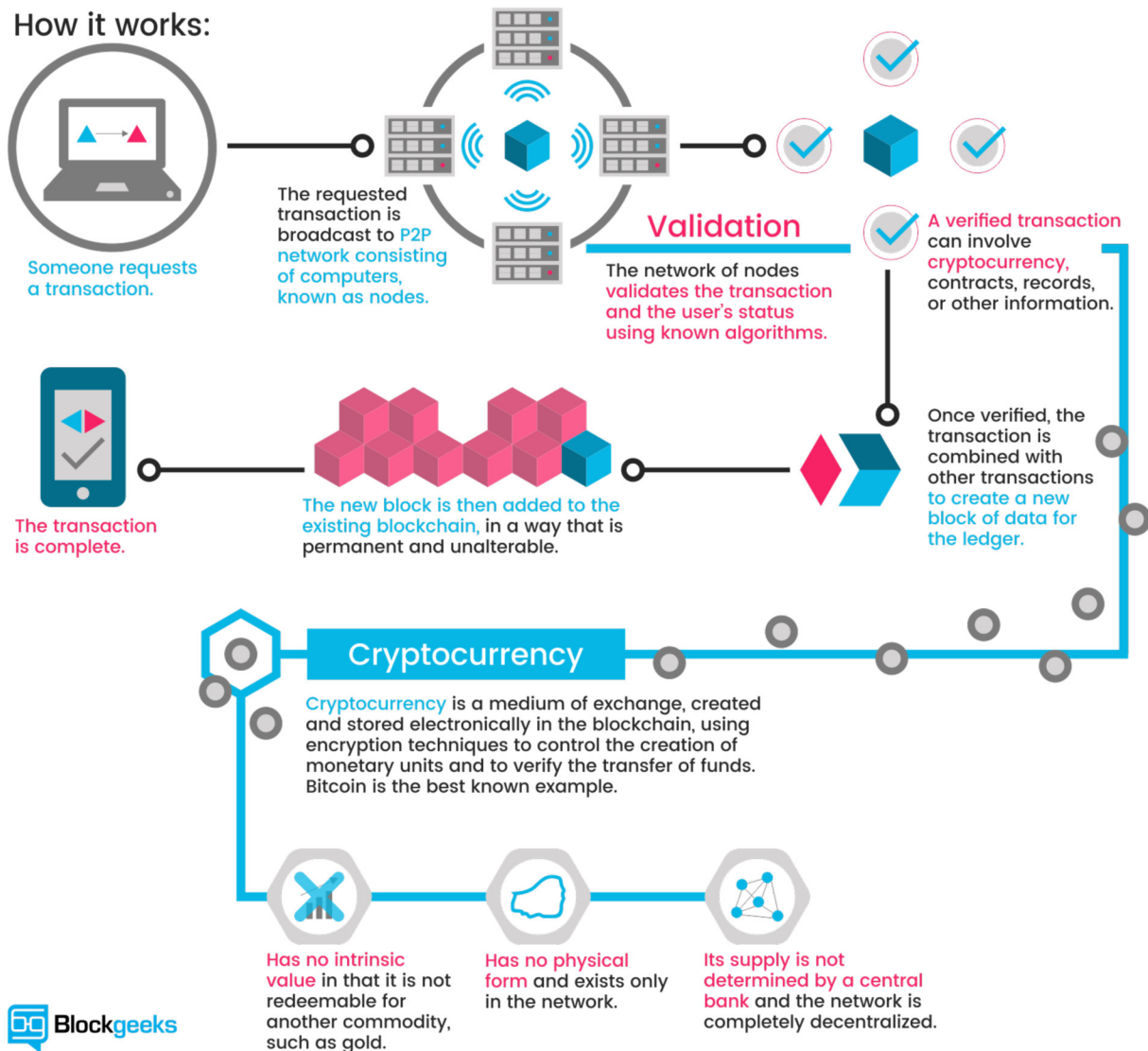


Figure 3: Blockchain Transaction Cycle (Source: <https://blockgeeks.com/>)

### 2.1.2 Data Mining

Please note, that the transaction model described above refers to the technological design of the Bitcoin network and can be fundamentally different when investigating other Blockchain networks. Responsible for verifying and linking blocks are special peers within in the network, called miners. They compete with each other in order to link a new block on top of the last block and therefore form a chronological sequence - a chain of blocks (Aste et al., 2017). The miner's work is based on the consensus mechanism proposed by the network, which allows people to agree or not agree on a transaction. This aims for the prevention of double-spending and fraud and is assured by a combination of complex cryptography and economic incentives for miners based on game theory (Hackett, 2017). "The miners that perform validation are required to show proof of work – consumption of electricity and use of

computing power – and are paid in new Bitcoins for their work” (Kshetri, 2017). Within the Bitcoin network “Each mined block contains a Coinbase transaction [...] which is allocated to the winning user. This mechanism is the only way to generate new Bitcoins in the system” (Aste et al., 2017).

### 2.1.3 Smart Contracts

As mentioned before, Blockchain doesn't only support the transaction or transfer of digital currencies. Therefore Blockchains like Ethereum, offer additional features, allowing the secure transaction of basically any kind of value, using the right computational linguistics. “Assets can be created on a network using smart contracts and can be tangible or intangible such as intellectual property, art, financial assets, car leases or shipping containers full of goods” (Siba et al., 2017). Furthermore, “Smart contracts can provide automatic and predictable execution, again removing the ability for third parties to subvert agreed-upon processes” (Gupta & Knight, 2017). Again, security for these value transactions and self-executing digital contracts is assured through a consensus mechanism. On the one hand “changing the terms of deals (or attempting to manipulate them) will be more challenging” (Tapscott & Tapscott, 2017), but on the other hand “the codes that underlie smart contracts are often short - 500 lines or less. This brevity increases the risk that there may not be sufficient certainty to be a contract in the legal sense. (Hoser, 2016). Lawyers, regulators and managing parties will need to learn how to audit legal templates and therefore assure, that the contractual software supports what both parties agreed upon (Tapscott & Tapscott, 2017).

### 2.1.4 Types of Blockchain

After understanding some of the basic principles of the technology, it is time to further distinguish between different types of Blockchain. The original idea of Blockchain, anonymously introduced by Satoshi Nakamoto, and adopted by other models such as before mentioned networks, like Ethereum, Ripple and IOTA is considered as public Blockchain. The Blockchain is open to everyone, free of charge and controlled by the consensus, rather than supervising centralized authorities.

In contrary, governments and companies are increasingly working on privatized versions of the technology. “A permissioned (private) Blockchain requires participants to be pre-selected or subject to gated entry. To verify information, a permissioned Blockchain may use either a consensus model, a subgroup of participants, or an administrator” (Hoser, 2016). Like this they are taking advantage of a faster and safer way to exchange value through the use of the

new technology, but keeping control over processes by supervising and monitoring the network. “Entries in a fully private Blockchain are monitored by a central authority of decision-making for writing permission. For read-permissions, it may be restricted to the participants or open to all the users. In a private Blockchain, an organization can list down the users based on the process of Know-Your-Business and Know-Your-Customer” (Siba et al., 2017). Privatized or restricted models, are especially attractive to many companies, and regulators, because they can leverage the speed and security of the technology, while staying in control. Although, it is hard to predict which model is more likely to be implemented in a company’s business model, since it depends on the purpose and key characteristics, which have to be covered by the technology. “Just as a business will decide which of its systems are better hosted on a more secure private intranet or on the internet, but will likely use both, systems requiring fast transactions, the possibility of transaction reversal, and central control over transaction verification will be better suited for private Blockchains, while those that benefit from widespread participation, transparency, and third-party verification will flourish on a public Blockchain” (Berke, 2017).

Between the two extremes, of fully public and private networks, there exists a continuum of partially decentralized Blockchains. Partially decentralized, in some cases also called Consortium Blockchains, constitute a hybrid between the presumably low-trust public Blockchains and the private version controlled by a single highly-trusted entity (Atzori, 2017).

## **2.2 Technology Acceptance Model (TAM)**

The TAM is a measurement scale originally developed by Fred D. Davis in 1989, in order to predict user acceptance of computer and information systems. “The present research develops and validates new scales [...], which are hypothesized to be fundamental determinants of user acceptance” (F.D. Davis, 1989). The theory is an extension of the Theory of Reasoned Action (Fishbein & Ajzen, 1975), which seeks to explain consumer purchasing behavior. TAM is an important analytical tool in the study of the social mechanisms of technology adoption and has received considerable attention throughout literature. “TAM has evolved to become a key model in understanding predictors of human behavior towards potential acceptance or rejection of the technology” (Marangunic & Granic, 2015).

Although empirical support for the model has varied depending on situation specifics, it remains a popular and useful scientific tool. “The technology acceptance model (TAM)

developed by Davis et al., (1989) is one of the most widely used and influential models in the field of information systems, technology and services” (Bugembe, 2010).

TAM has been used to analyze technology acceptance throughout a wide range of different computer based applications and information technology. “The original scales for measuring the TAM constructs have been confirmed to be reliable and valid in several replications and applications spanning a range of technologies and user populations” (Fred D. Davis & Venkatesh, 1995). In particular, extended version have been proven especially helpful in the investigation of web-based technologies and financial applications and are therefore also considered feasible for the research on Blockchain technology. Previous applications of the model include research on the implementation of online banking in India (Roy & Kesharwani, 2012), the adoption of online shopping (Ashraf, Thongpapanl, & Auh, 2014), predicting intention to use of e-banking (Rahi, Ghani, & Alnaser, 2017) and the analysis of Bitcoin Adoption (Folkinshteyn & Lennon, 2016), to just name a few.

In his paper, Davis (1989) concluded that the adoption of innovation is mainly influenced by two variables: ‘Perceived Usefulness’ and ‘Perceived Ease of Use’.

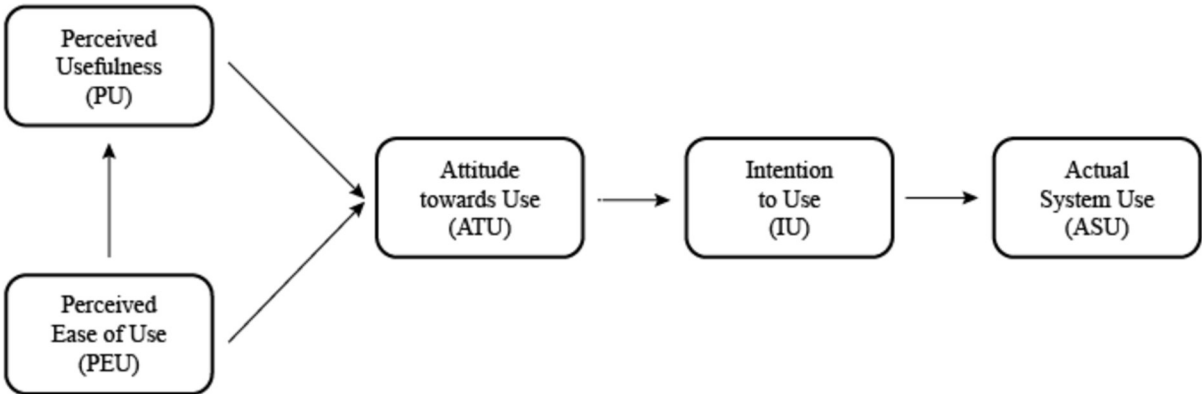


Figure 4: TAM by Davis (1989)

The model suggests that PU and PEU of information technology are the major determinants of its usage. IU is determined by the ATU of a system, which ultimately leads to ASU.

### 2.2.1 Perceived Usefulness (PU)

In general PU has been described as one’s subjective perception of a technology’s ability to increase job performance, resulting in an indirect effect on the user’s technology acceptance. “People tend to use or not use an application to the extent they believe it will help them perform their job better. We refer to this first variable as Perceived Usefulness” (F.D. Davis,

1989). Following from the definition of the word useful: “capable of being used advantageously” (F.D. Davis, 1989), “a system high in perceived usefulness, [...] is one for which a user believes in the existence of a positive use-performance relationship” (F.D. Davis, 1989). Ultimately, PU can be defined as follows:

**“The degree to which a person believes that using a particular system would enhance his or her job performance.”**

(F.D. Davis, 1989)

Considering the current technological progress of Blockchain the ASU will be excluded from the conceptual model used for this paper, since end-user applications are scarce. ASU at this moment in time is therefore hardly predictable. Bearing previous assumptions and researchers’ experience in mind, the following hypothesis can be derived for the technology at hand:

**H3a:** Perceived Usefulness is positively related to the Intention to Use Blockchain.

### 2.2.2 Perceived Ease of Use (PEU)

In general PEU has been defined as one’s subjective perception of a technology’s effortlessness, resulting in an indirect effect on the user’s technology acceptance. “If potential users believe that a given application is useful, they may, at the same time, believe that the system is too hard to use and that the performance benefits of usage are outweighed by the effort of using the application. That is, in addition to usefulness, theorized to be influenced by Perceived Ease of Use” (F.D. Davis, 1989). Following from the definition of the word ease: “freedom from difficulty or great effort” (F.D. Davis, 1989), “an application perceived to be easier to use than another is more likely to be accepted by users” (F.D. Davis, 1989). Ultimately, PEU can be defined as follows:

**“The degree to which a person believes that using a particular system would be free of effort.”**

(F.D. Davis, 1989)

PEU has been established from previous research to be an important factor influencing user acceptance and usage behavior of information technologies (Igbaria, Iivari, & Maragahh, 1995). Considering the relationship between PU and PEU and again, excluding ASU, the following hypotheses have been derived:

**H2a:** Perceived Ease of Use is positively related to the Perceived Usefulness of Blockchain.

**H2b:** Perceived Ease of Use is positively related to the Intention to Use Blockchain.

### 2.2.3 TAM Limitations & Extensions

“Understanding why individuals accept or reject systems has proven to be one of the most challenging issues in information systems research” (Davis, Bagozzi, & Warshaw, 1989). Even though TAM is believed to represent an important theoretical contribution towards understanding and predicting acceptance and usage of information systems, several researchers mention that TAM is incomplete in several aspects.

The model is based on self-reported, perceived aspects, rather than provable facts, which has been noted by numerous researchers. “What TAM actually measures is the variance in self reported use. Obviously this is not a precise measure. [...] At best, self reported use should serve as a relative indicator” (Legris, Ingham, & Collette, 2001). “We are asking persons to go well beyond and to engage in a higher-order cognitive process - a process that involves not only recall but weighting, inference, prediction, interpretation and evaluation. Many times during a brief interval, we are requiring the respondents to work at a fairly high level of abstraction. Thus, the data we obtain is already quite a few steps removed from the level of discrete stimuli and responses” (Podsakoff & Organ, 1986).

Researchers use self-reported usage as a substitute for actual usage. “However, to be an effective surrogate, self-report usage must be a valid measure of use correlating strongly with other methods of measuring usage” (Szajna, 1996). “The correlation of self-report usage with intentions is higher than its correlation with actual usage, providing little support for discriminant validity” (Szajna, 1996). This is not a surprise, given that “all the constructs of the TAM are self-report (ease of use, usefulness, and intentions) and when correlated with self-report usage, common method variance becomes an important factor (Podsakoff and Organ 1986). Nonetheless, researchers agree that “despite the rarified form of response to a scale measuring a personality, environmental or attitudinal variable, the result is still a

measure” (Podsakoff & Organ, 1986) and “it seems that organizational researchers do not like self-reports, but neither can they do without them” (Podsakoff & Organ, 1986).

The straightforward and simple approach of TAM is one of the reasons of its widespread use. “However, while parsimony is TAM’s strength, it is also the model’s key limitation” (Venkatesh, 2000). That is why TAM has been continuously modified and integrated into different constructs since its introduction. In order to match specific research needs many researchers suggested that TAM needed to be given additional variables to provide an even stronger model. Therefore, several extensions and variations of the model have been designed, adding organizational dynamics and social influences (Venkatesh & Davis, 2000), cost variables (Chen & Hitt, 2002), integrated version combining TAM with other theories (Taylor & Todd, 1995) and a specific design for testing e-commerce and online applications (Pavlou, 2003), to just name a few.

It seems that literature agrees on the fact that TAM is not a perfect way to measure technology acceptance, but limitations are reasonable and the model has been used, improved, modified and integrated in numerous papers according to the researchers’ specific needs.

### 2.3 Extended TAM: The e-Commerce Acceptance Model

By using the TAM in a Blockchain context, it is worthwhile taking a closer look on the extended version, referred to as the e-Commerce Acceptance Model (Fig. 5), testing online-based applications.

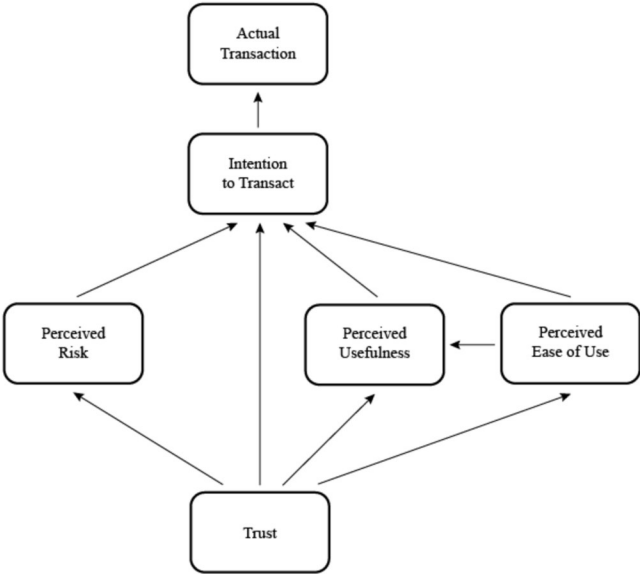


Figure 5: The e-Commerce Acceptance Model by Pavlou (2003)

Pavlou (2003) has extended the original design of the TAM model in order to meet aspects especially salient to applications such as the Internet, e-commerce or mobile applications. “The practical utility of considering TAM, stems from the fact that e-commerce is heavily technology-driven” (Pavlou, 2003). The dependent variables ‘Intention to Transact’ and ‘Actual Transaction’ are the primary constructs to determine consumer acceptance of e-commerce. Furthermore, the proposed model integrates additional key drivers, crucial to the acceptance of online-based applications, such as ‘Perceived Risk’ and ‘Trust’. “Trust and perceived risk are considered because of the uncertainty of the e-commerce environment” (Pavlou, 2003). These assumption can be directly translated to the Blockchain environment. “Electronic commerce acceptance is broadly described as the consumer’s engagement in electronic exchange relationships” (Pavlou, 2003). These relationships typically involve several activities like basic data exchange from the retailer to the consumer, consumer providing some personal information and the provision of private and monetary information, in order to complete the purchase of a product or service (Pavlou, 2003). Just like the original TAM by Davis (1989), Pavlou’s model explains the positive relationship between PEU and PU. However, ATU variable has been eliminated and instead Pavlou (2003) suggests a direct influence of PEU and PU on the intention to use or transact. By adding the variable PR he suggests a third direct influence. All this is mediated by the ‘Trust’ variable ultimately leading to the actual use or transaction of a system.

### 2.3.1 Perceived Risk (PR)

There are several similarities between the use of Blockchain-based applications (BBA) and e-commerce, involving the exchange and transaction of value in an open, online-based and global network. “The distant and impersonal nature of the online environment and the implicit uncertainty of using a global open infrastructure for transactions have rendered risk an inevitable element of e-commerce” (Pavlou, 2003), and therefore will be also considered for the analysis of Blockchain.

Bauer (1960) notes that the two primary structural dimensions of risk are uncertainty and consequences which much, but not all, subsequent research in perceived risk has used in the measurement procedure. He strongly emphasizes that he is concerned only with subjective (perceived) risk and not "real world" (objective) risk. Therefore, PR can be defined as follows:

**"Perceived risk in consumer behavior involves risk in the sense that any action of a consumer will produce consequences which he cannot anticipate with anything approximating certainty, and some of which at least are likely to be unpleasant."**

(Bauer, 1960)

Other studies have considered perceived risk as the consumer's expectations of suffering loss in pursuit of a desired outcome" (Kumpajaya & Dhewanto, 2015). For online transactions in particular, two forms of uncertainty are naturally present: behavioral uncertainty and environmental uncertainty (Bensaou & Venkatraman, 1996). Meaning that risk is either technology-driven, arising from the underlying infrastructure - environmental risk; or relational resulting from the trading partner - behavioral risk (Ring & Van De Ven, 1994). Even though Blockchain promises a secure and transparent network, its distributed and anonymous nature involving transactions of value might draw suspicion among end-users. Behavioral risks, perceived by end-users, include product misrepresentations, false identity demonstrations, private information leaks, misleading advertising, and denunciations of warranties (Pavlou, 2003).

"Environmental uncertainty exists mainly because of the unpredictable nature of the Internet, which is beyond the full control of the web retailer or the consumer" (Pavlou, 2003). Again, Blockchain assures the highest digital security standard through cryptography as of today, using DLT and PKI, nonetheless there is still a possibility that processes can be tampered. Traditional examples of environmental risks are breaches and thefts of private information by hackers. According to Pavlou (2003), behavioral and environmental risk can be further discriminated into the following dimensions:

1. Economic Risk - Possibility of monetary loss.
2. Performance Risk - Imperfect technological infrastructure
3. Privacy Risk - Opportunity to disclose private consumer information
4. Time Risk - Potential loss of time associated with researching and learning about the technology

It is important to mention that the tamper-proof and trustless environment of Blockchain might eradicate or at least minimize these risk factors from a technological point of view.

Although, this doesn't eliminate they perceived risk of end-users. Therefore the following hypothesis has been derived:

**H4a:** Perceived risk is negatively related to the Intention to Use Blockchain.

### 2.3.2 Level of Knowledge (LK)

“No term at present is more hyped, and more poorly understood” (Hackett, 2017). Therefore, one of the biggest factors of a widespread technology acceptance is knowledge or education, meaning the distribution of information (Valenzuela, 2015). Literature agrees that education, or in other words the level of knowledge, is crucial for not only the acceptance of any technological system, but also for a widespread use of Blockchain.

As mentioned before, the TAM is based on mainly self-reported variables like PU, PEU and PR. Pavlou (2003) suggested implementing an additional variable ‘Trust’ as a mediating factor. Although, when using the TAM in a Blockchain context it seems that the ‘Level of Knowledge’ is an even more important factor than trust. With an increasing LK about the nascent Blockchain technology and the way it is designed ‘Trust’ is assumed to be negligible, since Blockchain is able to establish a trustless network. Therefore, the additional factor in this research will be LK.

The LK will be measured based on the Level of Knowledge Use Survey (LOKUS) Instrument introduced by Stone (2013). The model is specifically designed to measure the current state of awareness, interest and/or use of new knowledge published in the field of technology (Stone, 2013). The LOKUS Instrument is shared among stakeholders through a web-based platform in order to assess their level of awareness. Participants will be exposed to a linear sequence of questions and distinct into different levels of knowledge based on their responses (Stone, 2013). Stone describes ten levels ranging from Non-Awareness to Use (Modification). Although, due to the early development and implementation stage of Blockchain the levels used in this study will be limited to only the first five categories:

- Level 1: Non-Awareness
- Level 2: Awareness
- Level 3: Interest (Orientation)
- Level 4: Interest (Preparation)
- Level 5: Use (Intended)

The exact description and implementation of these five levels can be seen in the methodology chapter, as well as in the Appendix 1. Further simplifications and adjustments of the model are in line with the proposed structure, where language and appropriate substitutions must be tailored to the context of the specific technology field at hand (Stone, 2013).

As described before, there's a general euphoria around Blockchain among those who are familiar with the topic, while a lack of knowledge draws suspicion. Hence four hypotheses have been derived, predicting the influence of the LK:

**H1a:** The Level Knowledge is negatively related to the Perceived Risk of Blockchain.

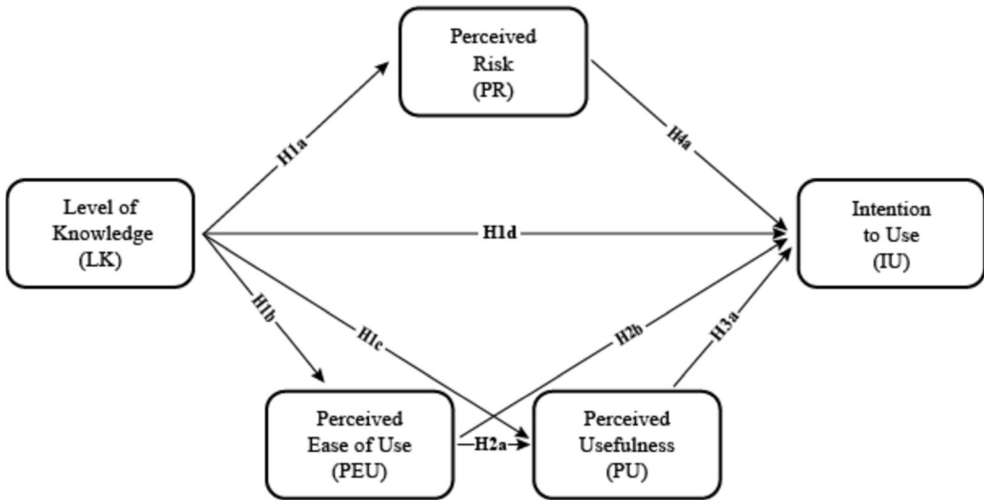
**H1b:** The Level of Knowledge is positively related to the Perceived Ease of Use of Blockchain.

**H1c:** The Level of Knowledge is positively related to the Perceived Usefulness of Blockchain.

**H1d:** The Level of Knowledge is positively related to the Intention to Use Blockchain.

**2.4 Modified TAM: Blockchain Acceptance Model**

Previous described findings and the technological analogy between e-commerce applications and Blockchain has led to the adoption of variables such as PR and the introduction of a new variable LK, the following combined multiple mediator model has been identified as the conceptual model used to explore the hypotheses introduced throughout the literature review (Fig. 6; Table 2).



**Figure 6:** Modified TAM - Blockchain Acceptance Model

<b>ID</b>	<b>Description</b>
<b>H1a</b>	The Level Knowledge is negatively related to the Perceived Risk of Blockchain.
<b>H1b</b>	The Level of Knowledge is positively related to the Perceived Ease of Use of Blockchain
<b>H1c</b>	The Level of Knowledge is positively related to the Perceived Usefulness of Blockchain
<b>H1d</b>	The Level of Knowledge is positively related to the Intention to Use Blockchain
<b>H2a</b>	Perceived Ease of Use is positively related to the Perceived Usefulness of Blockchain
<b>H2b</b>	Perceived Ease of Use is positively related to the Intention to Use Blockchain
<b>H3a</b>	Perceived Usefulness is positively related to the Intention to Use Blockchain
<b>H4a</b>	Perceived risk is negatively related to the Intention to Use Blockchain

**Table 2:** Hypotheses

If compared to the e-Commerce Acceptance Model shown before, two major adjustments have been made. Firstly, LK has replaced the suggested independent variable ‘Trust’, as described in the previous chapter. Secondly, the variable ASU or ‘Actual Transaction’ has been removed from the model since at the time this research has been conducted no feasible or commonly known Blockchain end-user application has been introduced to the market, besides trading with cryptocurrencies, which has no meaning for the actual technology. Therefore, collecting and analyzing data for the ASU of Blockchain-based applications is negligible.

The modified TAM model can be seen as a combined multiple mediator model, where LK represents the Independent Variable (IV) and IU represents the Dependent Variable (DV), sharing a direct effect with each other. In addition to that, the three mediators PEU, PU and PR have been adopted from the literature. Given that TAM and modified versions of the model have been successfully implemented throughout comparable studies, it will be the selected theoretical framework to predict end-user acceptance of Blockchain. The exact constructs measuring the variables as well as their relationships will be further described in Chapter 3.

## **2.5 Conclusion Literature Review**

Based on an in-depth literature review, Blockchain technology has been defined by its key characteristics in order to introduce the reader to the topic at hand and provide basic knowledge. Through the qualitative approach it was possible to answer the first research question of this study. The results answering RQ1 can be seen in Chapter 4.

**RQ1:** “What is Blockchain Technology? What are its key characteristics?”

Furthermore, this chapter represents detailed descriptions of the TAM and its individual variables used in order to answer the remaining research questions.

**RQ2:** “What is the current level of knowledge about Blockchain among potential end-users?”

**RQ3:** “How does the level of knowledge influence the perception on Blockchain?”

**RQ4:** “What are the main drivers on a person’s likelihood to use Blockchain?”

## **CHAPTER 3: METHODOLOGY**

This chapter presents and explains the methodology used to study the subject at hand and to reach conclusions about the hypotheses formulated in chapter 2. To gather the appropriate information that would allow answering the four key research questions, both primary and secondary data have been used.

### **3.1 Review of Conceptual Model and Research Approach**

For this study both exploratory and explanatory research approaches were used. Qualitative research, using secondary data, was conducted in the form of an in-depth literature review gathering important and accurate information about Blockchain and its key characteristics, while also defining the variables used in the conceptual model. Data was drawn largely from documents and archival records posted to the World Wide Web. The goal of the exploratory approach is to help better understand the nascent Blockchain technology, the components of the conceptual framework and to provide further context and guidance to the reader.

The conceptual framework granted the collection of primary data regarding self-reported measures. As mentioned before, the quantitative research is based on the modified version of the TAM (Chapter 2.4). The model measures the effect of five end-user's perceptual variables: LK, PU, PEU, PR and IU. Data for this explanatory approach has been collected through an online questionnaire with the goal to identify cause-and-effect relationships between the constructs.

### **3.2 Data Collection**

A survey was administered to gather quantitative data according to the proposed conceptual model. Therefore, the primary goal of this questionnaire was to evaluate end-user traits (LK, PU, PEU, PR) that predict the intention to use Blockchain.

The survey was composed by 18 questions and was distributed through e-mail and social networks such as Facebook and LinkedIn (Appendix 1). The survey had no geographic or demographic restrictions, and was shared only in English language between November 26<sup>th</sup> and December 10<sup>th</sup> 2017.

The survey flow included different branches and can be described as follows. After collecting demographic data, participants were asked about their level of Blockchain-knowledge and were allocated to three different branches, which separated participants according to their level of knowledge and a randomization factor. People who were at least aware of Blockchain, meaning were considered level two or above, were immediately asked to indicate

their perceptual opinion on PU, PEU, PR and IU. Participants unaware of Blockchain, meaning level 1, were further divided according to the randomization factor. While half of those people unaware of Blockchain were provided with a short explanation before continuing to answer, the other half was directly asked to indicate their perception on PU, PEU, PR and IU. The purpose of this randomized distribution was to set up a control group and measure the effect of education on the perceptual variables. The survey design is available in Appendix 1. The exact measurement constructs are further described in the next chapter.

### **3.3 Construct Measurements**

Based on relevant literature, reliable and applicable measurement constructs have been selected in order to support this study. While the majority of the constructs were directly adopted from literature, others were slightly modified to better fit the research topic at hand. Measurements for PU and PEU were incurred from the F.D. Davis (1989), which proofed to be consistent throughout multiple sources and different modifications of the TAM. The IU was measured according to Cheng, Lam, & Yeung (2006), who effectively used the TAM in an online-banking context. In addition to that, Featherman & Pavlou (2002) successfully implemented the PR variable into the TAM, and therefore the construct has been inherited for this study. Although, in order to reduce complexity and considering the early development and implementation stage of Blockchain, measurements for psychological risk and social risk have been left out in this case. The biggest adjustments have been made on the so-called Level Of Knowledge Use Survey (LOKUS) Instrument, introduced by Stone (2013). “LOKUS can be modified to fit as many reported findings as desired within any technology related-field” (Stone, 2013). Again, in order to fit the nascent Blockchain technology, the number of suggested knowledge levels has been reduced from ten to five, as seen in the literature review. Participants either agree or disagree with statements designed to measure their current state of awareness, interest and/ or use of Blockchain. The five levels of knowledge range from non-awareness over interest to initial use.

The constructs and their source along with the number of items used in this survey are displayed in Figure 7. All constructs used, besides the previously described LOKUS Instrument, were measured using a 5-point likert-scale, ranging from “Extremely Unlikely” to “Extremely Likely” or “ Strongly Disagree” to “Strongly Agree”.

<b>Operational Model</b>		
<b>Construct</b>	<b>Literature for Items</b>	<b>Number of Items</b>
Level of Knowledge (LK)	(Stone, 2013)	1-5
Perceived Usefulness (PU)	(F.D. Davis, 1989)	6
Perceived Ease of Use (PEU)	(F.D. Davis, 1989)	6
Perceived Risk (PR)	(Featherman & Pavlou, 2002)	8
Intention to Use (IU)	(Cheng, Lam, & Yeung, 2006)	6

**Figure 7:** Proposed constructs, relevant literature source and number of scale items

Please note that the number of items for LK varies among participants, according to their responses. The number of items reflects the assessed level of knowledge in an ascending order.

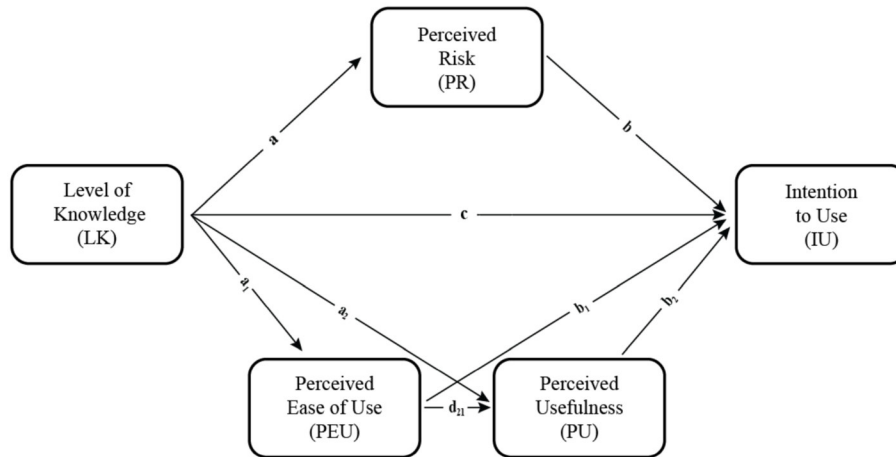
### **3.4 Data Analysis**

All data extracted from the online survey was analyzed using the IBM SPSS Statistics Software. Descriptive statistics and frequencies were generated to get insights about the sample and the constructs at hand. Furthermore, the appropriate degree of reliability regarding each of the constructs was identified by calculating Cronbach's Alpha (Chapter 4.2.2).

The conceptual model proposes several relationships among the predictor variables (LK, PEU, PU, PR) and the outcome variable (IU). In order to test those effects, several Simple and Multiple Linear Regression Analyses have been conducted, measuring each relationship individually and therefore either accept or reject the related hypotheses. The Regression analysis is one of the most methods to determine the predictability potential of the independent variables on the dependent variable. All statistical tests were carried out considering a minimum of 5% significance level.

A mediation model, using Multiple Linear Regressions, was used to estimate the indirect effects within the model through an intermediary or mediator variable. The mediator variable helps to further explain the relationships within the conceptual framework at hand.

The combined multiple mediation model used to identify direct and indirect or mediating effects can be seen in Figure 8.



**Figure 8:** Combined Multiple Mediation Model

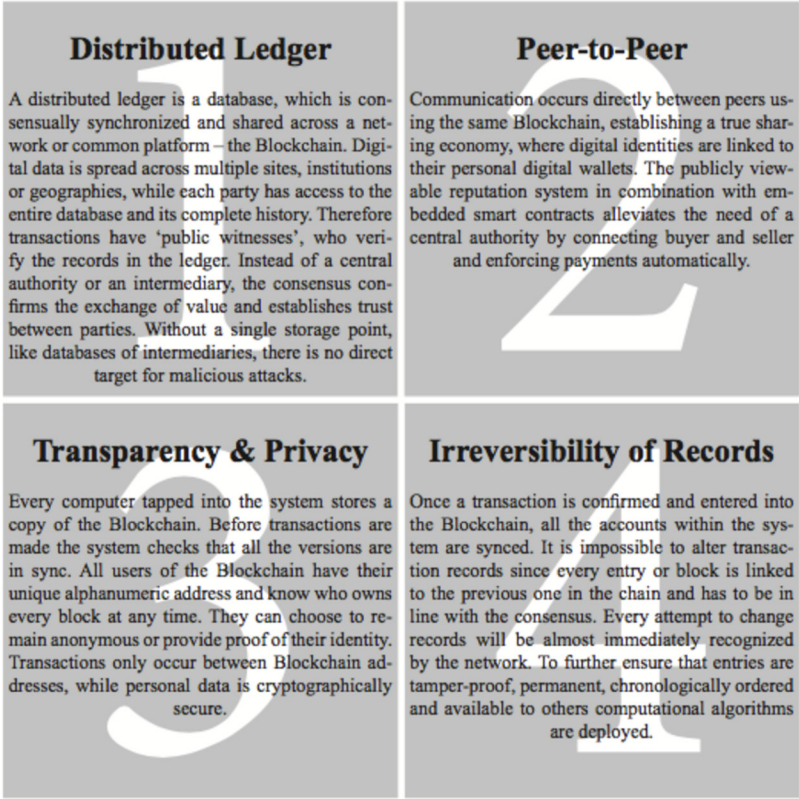
The model illustrates a direct effect  $c$  between LK and IU and an indirect effect of LK on IU through PR, as well as the paths visualized by the paths  $a$  and  $b$ . There are direct and mediating effects on IU resulting from each predictor variables, described by combinations of the paths  $a_1$ ,  $a_2$ ,  $b_1$ ,  $b_2$  and  $d_{21}$ .

**CHAPTER 4: RESULTS AND DISCUSSION**

Based on the outcome of Chapter 2.1 and in order to better understand and define the underlying topic of this study, a matrix describing the key characteristics of Blockchain technology has been developed answering the first research question proposed (Chapter 4.1). The empirical study refers to the online survey. 509 valid answers were collected through the online questionnaire. Through the randomization, as described in the methodology chapter, participants ranking in the first level of knowledge were evenly separated into two sub-groups. Out of the 328 non-aware people, 160 received additional information and are therefore forming the control group, which leaves a sample of 349 for the subsequent inferential statistics (Chapter 4.2.4).

**4.1 Qualitative Research**

Taking current research and previously introduced concepts into account (Chapter 2.1), a selection of core principles defining Blockchain has been derived. The four key characteristics summarize and represent crucial aspects of the technology, as seen in Figure 9. The matrix helps the researcher as well as the reader to get a fast and profound idea of Blockchain, based on current literature using high-quality scientific papers and articles.



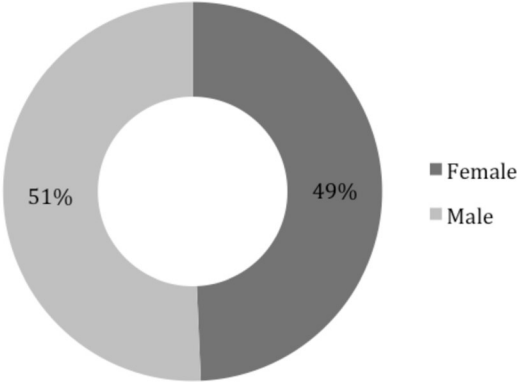
**Figure 9:** Blockchain Matrix - Key Characteristics

**4.2 Quantitative Research**

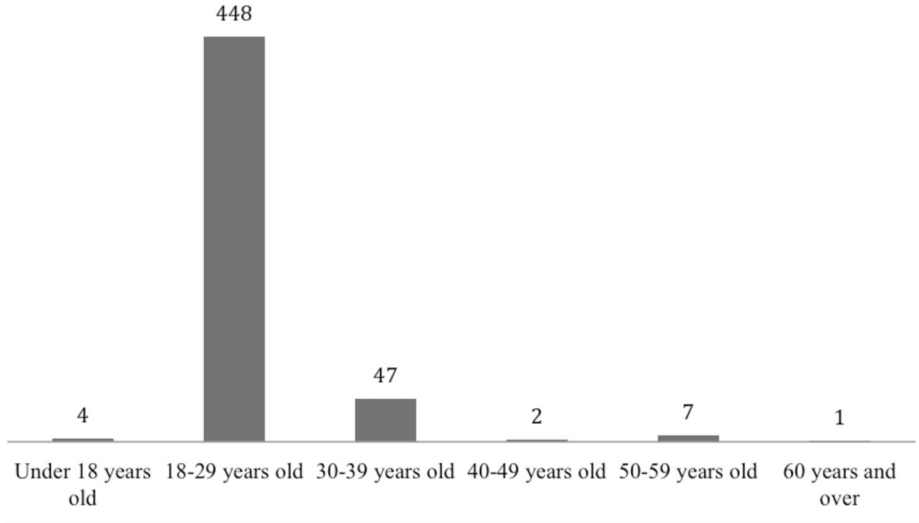
By conducting an online questionnaire referring to the previously introduced constructs of the TAM and based on profound literature the following results have been derived. Please note that a detailed presentation of all the statistical tests performed in order to get the reported results can be found in the Appendix.

**4.2.1 Sample Characterization**

Focusing on descriptive statistics of the sample population, one can see that the questionnaire was evenly answered by female and male participants (251 and 258 respectively) as seen in Figure 10 (Appendix 2), while being vastly dominated by young people between 18 and 29 years old, representing 88% of the sample (Fig. 11; Appendix 2).

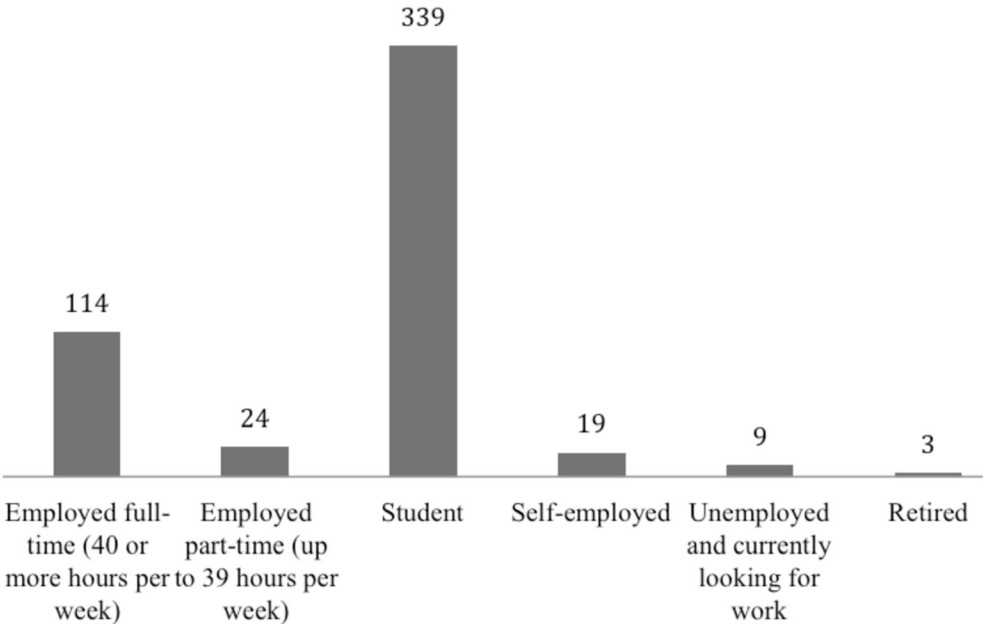


**Figure 10:** Gender Distribution

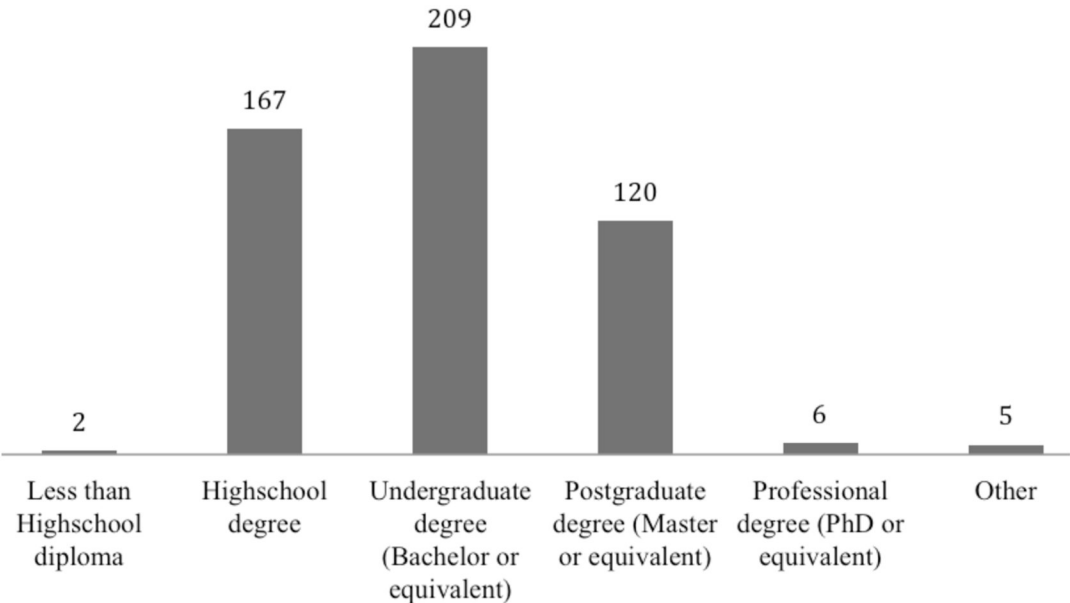


**Figure 11:** Age Distribution

By looking at the current employment status the vast majority of people identified as students (Fig. 12; Appendix 2). In relative figures around 67% of the sample population are students and 22% are working full-time. Overall, it appears to be a considerably educated sample, as most participants have completed either their bachelor degree (41%) or a Master’s degree (24%). About 33% stated their highest level of education as Highschool Degree (Fig. 13; Appendix 2).

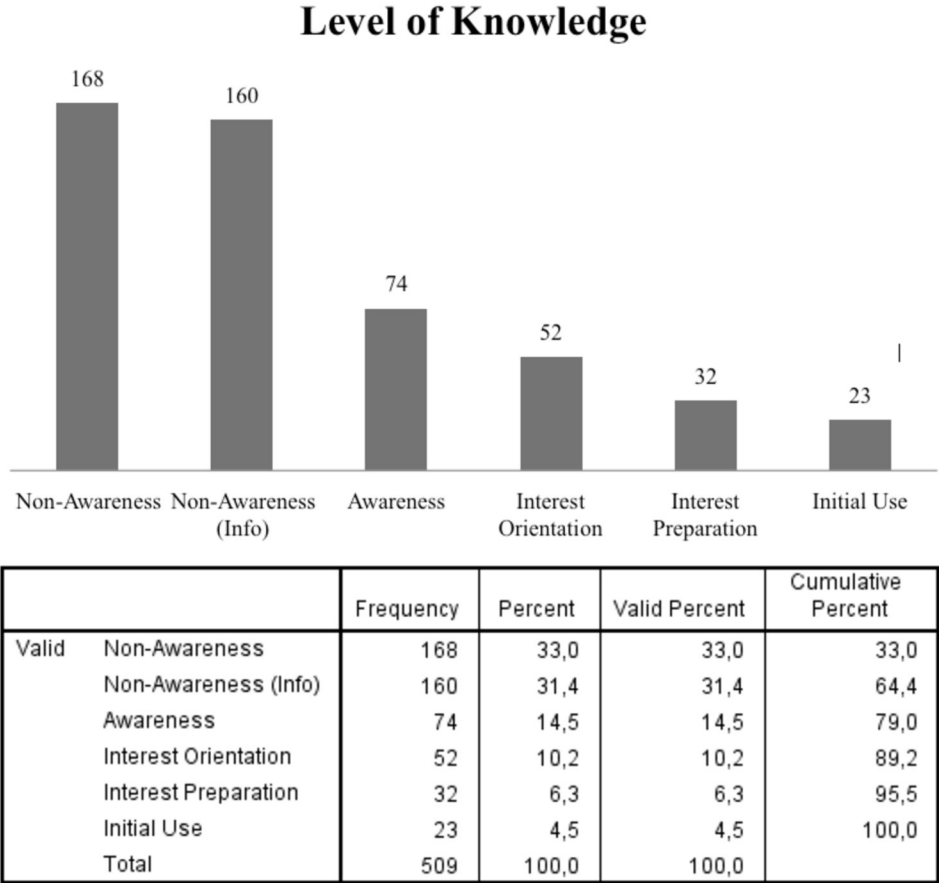


**Figure 12:** Employment Status



**Figure 13:** Education Level

After getting an idea of the demographic distribution of the sample, we have a closer look at the measured LK about Blockchain. Around 64% have never heard about Blockchain before, this can be seen by the cumulative percentage of non-aware people, where around half of them have been given additional information afterwards (Fig. 14; Appendix 3). In addition to that, one can see that the number of participants continuously decreases in regards to an increasing LK.



**Figure 14:** Level of Knowledge - Descriptive Statistics

4.2.2 Reliability of Constructs

Before further analyses of the results the constructs at hand have been tested in regards to their reliability (Appendix 4). Do determine whether the single items of each measure fit together and therefore relate to each other as a group, a reliability analysis has been conducted. The Cronbach’s Alphas are shown in Figure 15 on the next page.

<b>Variable</b>	<b>Cronbach's Alpha</b>	<b>Number of Items</b>
Perceived Ease of Use (PEU)	0,89	6
Perceived Usefulness (PU)	0,93	6
Perceived Risk (PR)	0,88	8
Intention to Use (IU)	0,92	6

**Figure 15:** Reliability Analysis

The reliability test was satisfactory, since the results were all above the required rule of thumb value of 0.6 (Sekaran, 2000). In fact, each of the constructs shows high values around 0.90, which indicates that all of them are consistent and reliable. Therefore, the items of each construct have been recoded and combined into separate variables for further analyses. A detailed look at those variables can be found in the following chapter.

#### 4.2.3 Descriptive Statistics for each Variable

In order to get insights about the self-reported variables, the mean, mode and standard deviation of each factor has been calculated (Fig. 16). Please note that for all calculation the control group has been excluded, leaving a sample of 349 people. Due to the nature of items used for the PR variable, PR has been reversed.

	<b>Perceived Ease of Use</b>	<b>Perceived Usefulness</b>	<b>Perceived Risk</b>	<b>Intention to Use</b>
<b>N Valid</b>	349	349	349	349
<b>N Missing</b>	0	0	0	0
<b>Mean</b>	3,25	3,22	2,85	3,04
<b>Mode</b>	3	3	3	3
<b>Std. Deviation</b>	0,70	0,99	0,81	0,84

**Figure 16:** Descriptive Statistics (PEU, PU, PR, IU)

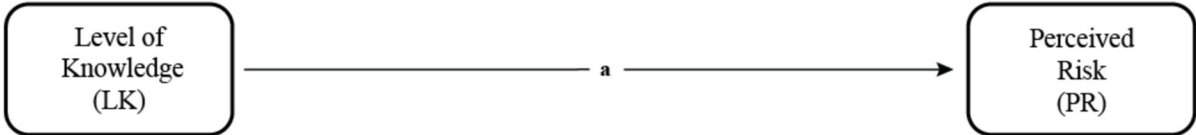
Overall most of the respondents had a neutral perception on the topics at hand, which can be seen by the mode of three in all categories. On average people responded to each variable with scores between 2.85 and 3.25, while PR shows the lowest scores and PEU the highest. The average spread of the scores is between .70 and .99. All Items have been measured on 5-point Likert scale.

4.2.4 Hypotheses Testing

In order to get a better idea of the relationships between the predictor variables (LK, PEU, PU, PR) and the outcome variable (IU), as well as testing the proposed hypotheses, several inferential statistics have been conducted. The conceptual model is simplified into single Simple and Multiple Linear Regression Analyses, measuring each of the effects independently. In addition to that, a preliminary analysis was performed to check whether there was no violation of the assumption of normality in order to assure data validity of the model (Appendix 5). The results show that besides the fact that LK is following a slightly positive skewed distribution, all other constructs confirm normal distribution in terms of skewness and kurtosis.

The Effect of LK on PR

In order to investigate the direct effect of LK on PR a Linear Regression Analysis has been conducted (Appendix 6), where LK functions as the predictor and PR as the outcome variable. The relationship, or direct effect has been described by path  $a$  (Fig.?).



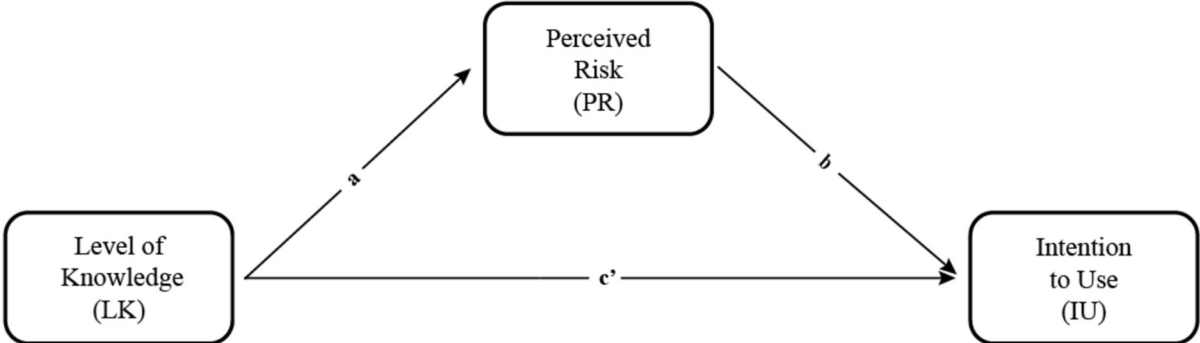
**Figure 17:** Effect of LK on PR

The model has a moderate quality in predicting PR from LK ( $R=.432$ ), where LK accounts for 18,5% of variance in PR ( $\text{Adj. } R^2=.185$ ). In addition to that, the model is appropriate and statistically significant in predicting PR ( $F=79.528$ ;  $p<.001$ ). If we increase LK by one unit then PR decreases by .277 units ( $B=-.277$ ) and therefore we can conclude that that there is a negative relationship between LK and PR. Thus, we accept the proposed hypothesis.

**H1a:** The Level Knowledge is negatively related to the Perceived Risk of Blockchain. ✓

The Effect of PR on IU

In order to investigate the effect of PR on IU a Multiple Linear Regression Analysis has been conducted (Appendix 7), where LK and PR are functioning as the predictors and IU as the outcome variable. The relationship between PR and IU has been described as path *b*. Furthermore, the mediation analysis shows and additional effect of LK on IU after controlling for the mediator. This effect is indicated by *c'* (Fig. 18). The difference between *c* and *c'* describes the indirect effect, while the product of *a* and *b* shows the total indirect effect of the mediation model.



**Figure 18:** Effect LK on IU through PR

The model has a very high quality in predicting IU from LK through PR ( $R=.933$ ), accounting for 86,9% of variance in IU ( $\text{Adj. } R^2=.869$ ). In addition to that, the model is appropriate and statistically significant in predicting IU ( $F=1153.292$ ;  $p<.001$ ). If we increase PR by one unit then IU decreases by .277 units ( $B=-.951$ ) and therefore we can conclude that that there is a negative relationship between PR and IU. Thus, we accept the proposed hypothesis.

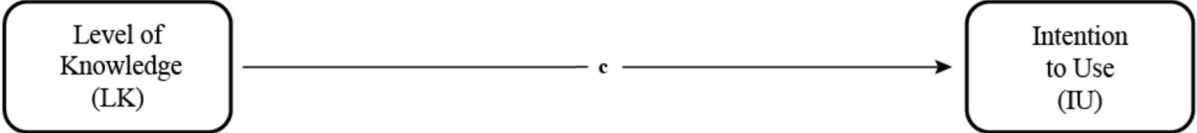
**H4a:** Perceived risk is negatively related to the Intention to Use Blockchain. ✓

The indirect effect described by  $c'$  ( $B=.022$ ) is not statistically significant ( $p=.123$ ) and therefore full mediation is assumed. The total indirect effect of the mediation model, caused by LK through PR is described by the following equation:

$$a \times b = -0,277 \times -0,951 = 0,263$$

The Effect of LK on IU

In order to investigate the direct effect of LK on IU a Linear Regression Analysis has been conducted (Appendix 8), where LK functions as the predictor and IU as the outcome variable. The relationship, or direct effect has been described by path  $c$  (Fig. 19).



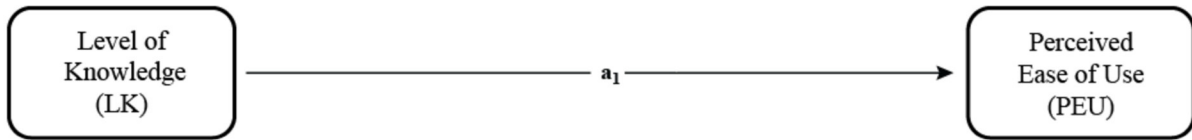
**Figure 19:** Effect of LK on IU

The model has a moderate quality in predicting IU from LK ( $R=.430$ ), where LK accounts for 18,3% of variance in IU ( $Adj. R^2=.183$ ). In addition to that, the model is appropriate and statistically significant in predicting IU ( $F=78.529$ ;  $p<.001$ ). If we increase LK by one unit then IU increases by .286 units ( $B=.286$ ) and therefore we can conclude that there is a positive relationship between LK and IU. Thus, we accept the proposed hypothesis.

**H1d:** The Level of Knowledge is a positively related to the Intention to Use Blockchain. ✓

The Effect of LK on PEU

In order to investigate the direct effect of LK on PEU a Linear Regression Analysis has been conducted (Appendix 9), where LK functions as the predictor and PEU as the outcome variable. The relationship, or direct effect has been described by path  $a_1$  (Fig. 20).



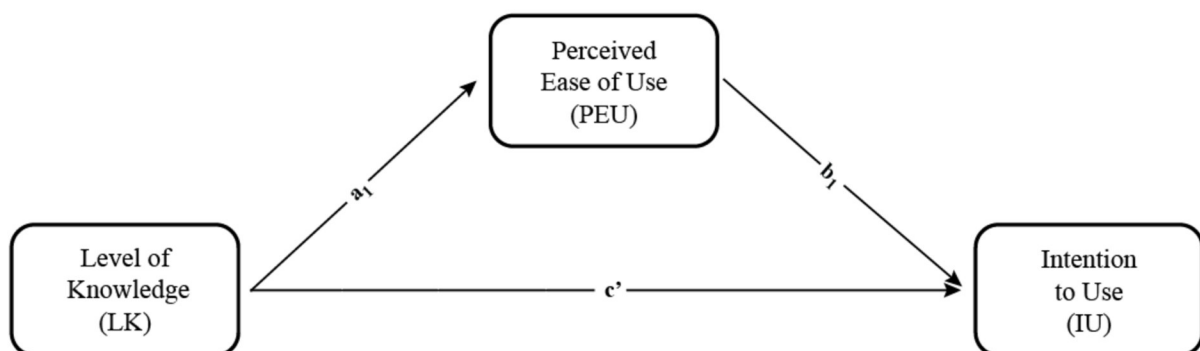
**Figure 20:** Effect of LK on PEU

The model has a weak quality in predicting PR from LK ( $R=.238$ ), where LK accounts for only 5,7% of variance in PEU ( $\text{Adj. } R^2=.057$ ). Nevertheless, the model is appropriate and statistically significant in predicting PEU ( $F=20.787$ ;  $p<.001$ ). If we increase LK by one unit then PEU increases by .131 units ( $B=.131$ ) and therefore we can conclude that there is a positive relationship between LK and PEU. Thus, we accept the proposed hypothesis.

**H1b:** The Level of Knowledge is positively related to the Perceived Ease of Use of Blockchain. ✓

The Effect of PEU on IU

In order to investigate the effect of PEU on IU a Multiple Linear Regression Analysis has been conducted (Appendix 10), where LK and PEU are functioning as the predictors and IU as the outcome variable. The relationship between PEU and IU has been described as path  $b_1$ . Furthermore, the mediation analysis shows an additional effect of LK on IU after controlling for the mediator. This effect is indicated by  $c'$  (Fig. 21). The difference between  $c$  and  $c'$  describes the indirect effect, while the product of  $a_1$  and  $b_1$  shows the total indirect effect of the mediation model.



**Figure 21:** Effect of LK on IU through PEU

The model has a moderate quality in predicting IU from LK through PEU ( $R=.483$ ), accounting for 22,9% of variance in IU ( $\text{Adj. } R^2=.229$ ). In addition to that, the model is appropriate and statistically significant in predicting IU ( $F=52.587$ ;  $p<.001$ ). If we increase PEU by one unit then IU increases by .273 units ( $B=.273$ ) and therefore we can conclude that there is a positive relationship between PEU and IU. Thus, we accept the proposed hypothesis.

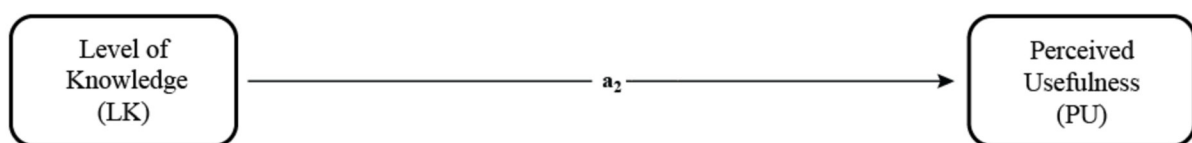
**H2b:** Perceived Ease of Use is positively related to the Intention to Use Blockchain. ✓

The indirect effect described by  $c'$  ( $B=.250$ ) is statistically significant ( $p<.001$ ) and therefore partial mediation is assumed. The total indirect effect of the mediation model, caused by LK through PEU is described by the following equation:

$$a_1 \times b_1 = 0,131 \times 0,250 = 0,036$$

#### The Effect of LK on PU

In order to investigate the direct effect of LK on PU a Linear Regression Analysis has been conducted (Appendix 11), where LK functions as the predictor and PU as the outcome variable. The relationship, or direct effect has been described by path  $a_2$  (Fig. 22).



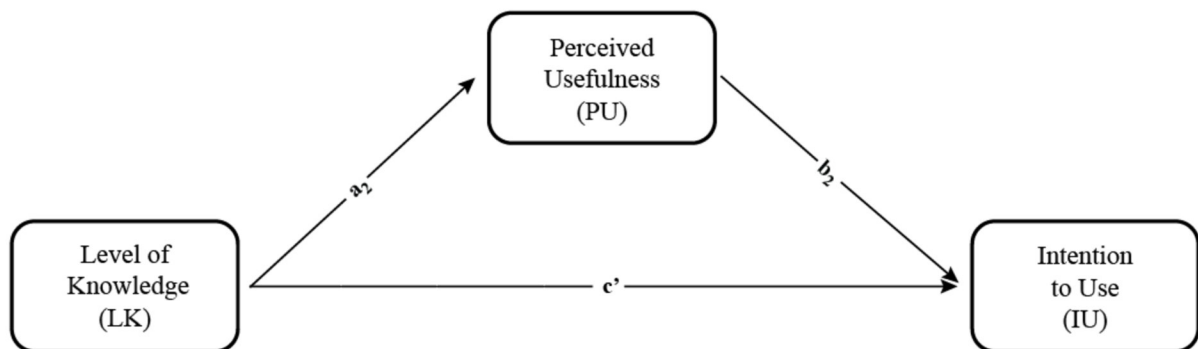
**Figure 22:** Effect of LK on PU

The model has a weak quality in predicting PU from LK ( $R=.305$ ), where LK accounts for only 9,1% of variance in PU ( $\text{Adj. } R^2=.091$ ). Nevertheless, the model is appropriate and statistically significant in predicting PEU ( $F=35.589$ ;  $p<.001$ ). If we increase LK by one unit then PU increases by .239 units ( $B=.239$ ) and therefore we can conclude that there is a positive relationship between LK and PU. Thus, we accept the proposed hypothesis.

**H1c:** The Level of Knowledge is positively related to the Perceived Usefulness of Blockchain. ✓

#### The Effect of PU on IU

In order to investigate the effect of PU on IU a Multiple Linear Regression Analysis has been conducted (Appendix 12), where LK and PU are functioning as the predictors and IU as the outcome variable. The relationship between PU and IU has been described as path  $b_2$ . Furthermore, the mediation analysis shows an additional effect of LK on IU after controlling for the mediator. This effect is indicated by  $c'$  (Fig. 23). The difference between  $c$  and  $c'$  describes the indirect effect, while the product of  $a_2$  and  $b_2$  shows the total indirect effect of the mediation model.



**Figure 23:** Effect of LK on IU through PU

The model has a high quality in predicting IU from LK through PU ( $R=.665$ ), accounting for 43,9% of variance in IU ( $\text{Adj. } R^2=.439$ ). In addition to that, the model is appropriate and statistically significant in predicting IU ( $F=136.772$ ;  $p<.001$ ). If we increase PU by one unit then IU increases by .452 units ( $B=.452$ ) and therefore we can conclude that there is a positive relationship between PU and IU. Thus, we accept the proposed hypothesis.

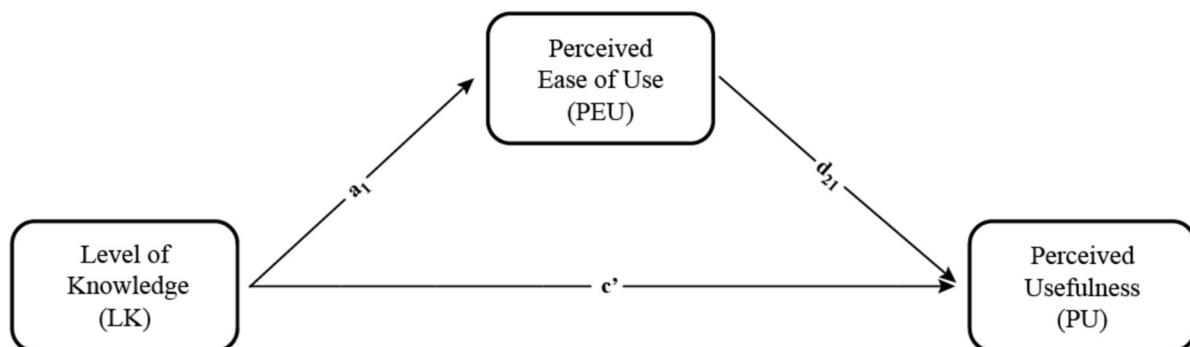
**H3a:** Perceived Usefulness is positively related to the Intention to Use Blockchain. ✓

The indirect effect described by  $c'$  ( $B=.178$ ) is statistically significant ( $p<.001$ ) and therefore partial mediation is assumed. The total indirect effect of the mediation model, caused by LK through PU is described by the following equation:

$$a_2 \times b_2 = 0,239 \times 0,452 = 0,108$$

### The Effect of PEU on PU

In order to investigate the effect of PEU on PU a Multiple Linear Regression Analysis has been conducted (Appendix 13), where LK and PEU are functioning as the predictors and PU as the outcome variable. The relationship between PEU and PU has been described as path  $d_{21}$ . Furthermore, the mediation analysis shows an additional effect of LK on PU after controlling for the mediator. This effect is indicated by  $c'$  (Fig. 24). The difference between  $c$  and  $c'$  describes the indirect effect, while the product of  $a_1$  and  $d_{21}$  shows the total indirect effect of the mediation model.



**Figure 24:** Effect of LK on PU through PEU

The model has a moderate quality in predicting PU from LK through PEU ( $R=.480$ ), accounting for 22,6% of variance in PU ( $\text{Adj. } R^2=.226$ ). In addition to that, the model is appropriate and statistically significant in predicting PU ( $F=51.714$ ;  $p<.001$ ). If we increase PEU by one unit then PU increases by .541 units ( $B=.541$ ) and therefore we can conclude that there is a positive relationship between PEU and PU. Thus, we accept the proposed hypothesis.

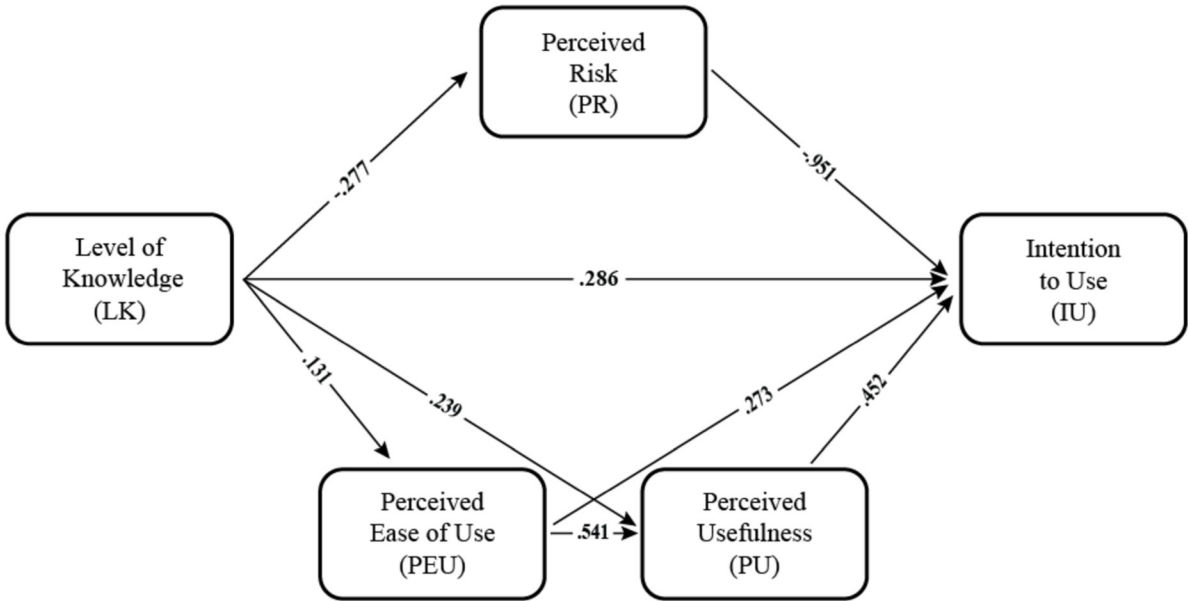
**H2a:** Perceived Ease of Use is positively related to Perceived Usefulness of Blockchain. ✓

The indirect effect described by c' (B=.168) is statistically significant (p<.001) and therefore partial mediation is assumed. The total indirect effect of the mediation model, caused by LK through PEU is described by the following equation:

$$a_1 \times d_{21} = 0,131 \times 0,541 = 0,071$$

Summary of Hypotheses Testing

Figure 25 illustrates the conceptual model including all values and directions of the effects supporting the proposed hypotheses. Please note, that the values have been calculated by breaking the model down into simple linear regression and mediation models. Therefore each of the effects has been calculated independently from the others, as described before.



**Figure 25:** Effect Sizes and Directions

In order to get a more detailed overview, all the results from the hypotheses testing can be seen in Table 3. The proposed hypotheses have been entirely confirmed and are based on statistically significant results. The relationships vary in their direction and quality of prediction. As expected beforehand, negative relationships can be seen between LK and PR as well as PR and IU. The strongest predictors of IU are PR and PU, whereas LK seems to lack some magnitude in its ability to predict other variables.

<b>Hypothesis Tested</b>	<b>Predictor Variable</b>	<b>Outcome Variable</b>	<b>Direct Effect</b>	<b>Model Quality</b>	<b>Direction of Relationship</b>	<b>Variance Explained</b>
<b>H1a ✓</b>	LK	PR	-.277	moderate	negative	18,5%
<b>H1b ✓</b>	LK	PEU	.131	weak	positive	5,7%
<b>H1c ✓</b>	LK	PU	.239	weak	positive	9,1%
<b>H1d ✓</b>	LK	IU	.286	moderate	positive	18,3%
<b>H2a ✓</b>	PEU	PU	.541	moderate	positive	22,6%
<b>H2b ✓</b>	PEU	IU	.273	moderate	positive	22,9%
<b>H3a ✓</b>	PU	IU	.452	high	positive	43,9%
<b>H4a ✓</b>	PR	IU	-.951	very high	negative	86,9%

**Table 3:** Hypothesis Testing

Besides the before mentioned direct effects several mediating, or indirect effects, have been identified. The results of the mediation analyses are listed in Table 4. Especially the model describing the indirect effect of LK on IU through PR is a considerably strong mediation model, in which most of the effect is contributed by the mediator (PR), while the independent variable (LK) shows no statistical significance. Therefore it is considered as a full mediation. The remaining models show partial mediation and low to moderate indirect effects.

<b>IV</b>	<b>M</b>	<b>DV</b>	<b>Direct Effect w/o Mediator (c)</b>	<b>Direct Effect w/ Mediator (c')</b>	<b>Indirect Effect (a*b)</b>	<b>Mediation Type (Sig.)</b>
LK	PR	IU	.286	.022	.263	Full Mediation
LK	PEU	IU	.286	.250	.036	Partial Mediation
LK	PU	IU	.286	.178	.108	Partial Mediation
LK	PEU	PU	.239	.168	.071	Partial Mediation

**Table 4:** Mediation Effects

#### 4.2.5 The Effect of Education

As previously described, around half of the non-aware participants received additional information about Blockchain before answering questions about their perception on PEU, PU, PR and IU. In order to investigate the effect of information on each variable Simple Linear Regression Analyses have been conducted (Appendix 14), where Info functions as the predictor variable. The results of the inferential statistics are listed in Table 5. Although, by

looking at the results, one can see that the effects are either statistically non-significant or negligible in terms of the measured effect. Therefore it assumed that information had no influence on the outcome of this study. Given the results no further analysis including the control group has been conducted.

<b>Predictor Variable</b>	<b>Outcome Variable</b>	<b>Direct Effect</b>	<b>Model Quality</b>	<b>Direction of Relationship</b>	<b>Variance Explained</b>
Info	PEU	.166	very weak	positive	1,3%
Info	PU	.159	not significant	positive	0,4%
Info	PR	.049	not significant	positive	0,2%
Info	IU	-.062	not significant	negative	0,1%

**Table 5:** Effects of Information on each Variable

**4.3 Discussion**

The first objective of this study was to get insights about Blockchain and its key characteristics. Described by the first RQ.

**RQ1:** “What is Blockchain Technology? What are its key characteristics?”

By performing an in-depth literature review based on relevant, reliable sources it was possible to aggregate the key characteristics defining the topic at hand. Therefore a Blockchain matrix summarizing key findings from qualitative research was developed. The matrix can be seen in the result section (Chapter 4.1).

Since Blockchain technology is based on public consensus and the initial idea described by Satoshi Nakamoto (2008) in his whitepaper is to make the financial system more efficient by cutting out intermediaries, Blockchain was supposed to benefit individuals rather than corporates and governments. Therefore, integration of society in such a socially influential

technological breakthrough is crucial to unfold its full socio-economic potential. In order to draw a picture about the current state of awareness in the field of Blockchain technology, an empirical study was conducted. By using the LOKUS Instrument (Stone, 2013) the second RQ has been addressed.

**RQ2:** “What is the current level of knowledge about Blockchain among potential end-users?”

Chapter 4.2.1 describes the outcomes of this analysis assessing the LK among end-users. It is worth mentioning, that the sample population was dominated by young students and professionals. The high percentage of these demographic groups answering the survey can be explained by the way it was distributed, focusing on social media channels and universities. Therefore, the sample is considered fairly educated. Bearing this in mind, the generally low LK among participants is quite surprising. Out of the 509 valid answers around 64% stated that they had never heard about Blockchain technology, which means just about a third of the sample population is at least aware. Especially when considering the previously described demographics, as well as the extensive media coverage nowadays, this is a really low LK. Other researcher already identified this issue. “No term at present is more hyped, and more poorly understood” (Hackett, 2017). The literature agrees, that one of the biggest obstacles to growth and the widespread use of the technology is education addressing the current lack of knowledge among stakeholders (Valenzuela, 2015). Therefore, the control group, included in the survey, was installed in order to measure the potential impact of education on the technology acceptance. Although, there was no significance in the statistical outcome of these effects.

After assessing the current LK among potential end-users, the next step was to measure the impact of LK on one’s perception about Blockchain. This obstacle has been addressed by the third RQ.

**RQ3:** “How does the level of knowledge influence the perception on Blockchain?”

The detailed results of the inferential statistics can be seen in Chapter 4.2.4. The regression and mediation analyses show, that there are statistically significant effects of LK on each of the other variables. LK has a positive effect on PEU, PU and IU, while being negatively correlated to the PR. Meaning, that by increasing one's LK, they start seeing more potential in the technology in terms of usefulness and convenience, while also being less suspicious. This can be seen as an indicator, that there is an effect of education, even though the implemented control group had no impact, as mentioned before. LK was in fact a significant predictor of the model but lacked some magnitude, showing weak to moderate effects and accounting for only 5,7-18,5% in the outcome of perceived values.

In addition to that, these variables were used to predict one's IU Blockchain. The quality of those predictors varies in their ability to forecast intended use. The results from Chapter 4.2.4 help to understand the objective addressed in the fourth RQ.

**RQ4:** “What are the main drivers on a person's likelihood to use Blockchain?”

All of the predictors (LK, PEU, PEU, PR) showed statistically significant effects on IU, some of them can be considered as strong and reliable, while others had little to moderate influence. The strongest impact is generated by PR, being negatively related to IU, followed by PU. The scarcity of known application of Blockchain demands an immense level of abstraction for people in order to state their PEU. Consequentially, PEU had little effect on the outcome of IU. Besides these direct effects, several mediating effects were identified, helping to explain variance in IU.

## **CHAPTER 5: CONCLUSIONS AND LIMITATIONS**

### **5.1 Conclusions**

Ultimately it can be said, that the proposed modified version of the TAM model was appropriate to test technology acceptance. The drivers ‘Level of Knowledge’, ‘Perceived Ease of Use’, ‘Perceived Usefulness’ and ‘Perceived Risk’ predicting the intended use and therefore the acceptance of Blockchain, have been proven effective. The constructs used in order to predict intended use were reliable and all hypotheses have been confirmed. Measuring the direct effect of education, by setting up a control group and handing out additional information to participants has been proven as not effective in this study. Although, there is no data supporting that respondents, who received the educational text in the questionnaire, understood or even read the description. Therefore, the data collection lacks quality in this case, being not able to reliably measure the impact of education on the overall model.

Answering the question whether society is ready for the expected Blockchain revolution, one can say, that the knowledge gap among potential end-users is extreme, even when analyzing a highly educated sample population. In fact society seems not to be prepared. This is also in line with the literature, often comparing the current state of development and acceptance of Blockchain with the Internet in the early 90’s. By getting a lot of attention from the regulators and economy, mainly the financial sector, society seems to drop behind, failing to grasp the significance and socio-economic impact of the technology at hand. The lack of awareness could therefore result in a disadvantage for society when it comes to the actual implementation of Blockchain-based applications. There is a risk, that regulators and companies will take advantage of the knowledge gap, by restricting and privatizing Blockchains at the cost of socio-economic potential and economical prosperity of individuals.

### **5.2 Managerial & Academic Implications**

#### 5.2.1 Managerial Implications

The study helps to better understand the people who will be affected by the technological Blockchain innovation and how to deal with them. When thinking about possible implementations of Blockchain technology, following a consumer-driven strategy, the study

identified four effective components. Striving for consumer acceptance, the most important aspect is to reduce the perceived risk among end-users, before leveraging the technology. The 'Perceived Risk' variable was by far the most impactful in predicting acceptance. Informing people about security features and establishing trust in technology and provider could minimize the perceived risk and push acceptance. A tool to enforce such effects could be the use of educative advertisement to raise the general level of knowledge. Besides building trust and educating people in Blockchain, companies could increase the perceived usefulness and ease of use among potential customers by developing practicable real-world applications, which would help society to grasp the magnitude and socio-economic potential and establish acceptance.

The literature considers Blockchain as one of the next big technological revolutions, comparable to the Internet, personal computers or smart-phones. Therefore, managers should stay up-to-date with current technological progress in order to secure the sustainability of their operations.

### 5.2.2 Academic Implications

While current research on Blockchain focuses on socio-economic barriers and potential, as well as proposed implications, a research gap was identified in terms of societal perception and level of awareness among end-users. By leveraging the TAM, it was possible to partially fill this gap and establishing the model in a Blockchain context, while helping to draw a picture of society's current level of knowledge, perception and intended use of Blockchain. The model has been proven to be appropriate and reliable, even when considering the early stage of Blockchain and the low level of knowledge throughout participants of this study.

By successfully implementing the new variable 'Level of Knowledge' into the extended e-Commerce TAM by Pavlou (2003), a new modified version of the TAM has been established. In addition to that, another tool has been used to anticipate the current level of knowledge among potential end-users. The LOKUS Instrument (Stone, 2013) is a rather new method, trying to assess a precise level discrimination of technological knowledge and/ or awareness. The model includes a high degree of freedom to researcher in terms of modification and implementation of the assessment tool. Nevertheless, it has proven to be practicable in context with Blockchain and turned out to be a decent construct measurement. Ultimately, the researcher was able to confirm all proposed hypotheses, by combining different conceptual models and creating new statistical constructs.

## **5.3 Limitations and Future Research**

### 5.3.1 Limitations

Even though the TAM has been successfully implemented into the Blockchain environment, there's still doubt about the reliability and precision of the model. Its straightforward and simple approach is one of the reasons of its widespread use, but also one of its key limitations. What TAM actually measures is the variance in self-reported variables and should rather be considered as a relative indicator than a precise measurement. Using the TAM in a Blockchain context, people are asked to engage in extreme levels of abstraction and high-order cognitive processes. The relevance of the model can be further questioned in regards to the outcome variable measuring intended use rather than actual system use. This makes profound conclusion about the actual acceptance of an information system such as Blockchain rather vague.

Besides that, Blockchain is a nascent technology, where little is known or proven in a real world practicable context. Current knowledge is mainly based on the imagination of researchers and Blockchain aficionados trying to forecast socio-economic effects and application concepts.

Furthermore, the study failed to measure the direct effect of education on the model. Setting up a control group and providing participants with additional information has not been effective. In this case, improvements in the data collection have to be considered.

Finally, the sample characterization was extremely skewed towards young students and professionals, meaning that profound conclusion about society in general are highly limited.

Considering all limitations, there is further room for improvement in terms of the research approach and data collection.

### 5.3.2 Future Research

In respect to future research in this academic field, it would be favorable to conduct a similar study improving the data collection especially with regards to the age distribution, in order to increase generalization reliability. The obstacle to measure the impact of education has not been successful and therefore a different methodology should be used to test this effect. Future research should consider alternative ways to assure that people actually read and understand the additional information given in the questionnaire, in order to reach statistical significance. A possible approach could be the implementation of a simple check box to the

survey, indicating whether the participants has read and understood the information provided. Also, the use of focus groups could be considered.

As of today, Blockchain is in an early stage of development, defined by a lack of regulations and real-world applications, thus far away from being market-ready. Therefore, it would be interesting to run similar tests when the technology is closer to the market introduction or first concrete applications are available.

After successfully implementing the TAM in the Blockchain environment, it would be desirable to test other conceptual models predicting technology acceptance, such as the MPT-Model by Scherer & Craddock (2002), or HMSAM (Lowry, Gaskin, Twyman, Hammer, & Roberts, 2013). After other models have been established, researcher can start comparing results and draw interdisciplinary conclusions.

## REFERENCE LIST

- Ashraf, A. R., Thongpapanl, N. (Tek), & Auh, S. (2014). The Application of the Technology Acceptance Model Under Different Cultural Contexts: The Case of Online Shopping Adoption. *Journal of International Marketing*,
- Aste, T., Tasca, P., & Centre, U. C. L. (2017). Blockchain Technologies: The Foreseeable Impact. *THE IEEE COMPUTER SOCIETY*.
- Atzori, M. (2017). Blockchain-Based Architectures for the Internet of Things: A Survey. *University College of London - Center for Blockchain Technologies*.
- Bauer, R. A. (1960). Consumer Behavior as Risk Taking.
- Bensaou, M., & Venkatraman, N. (1996). Inter-organizational relationships and information technology: A conceptual synthesis and a research framework. *EUROPEAN JOURNAL OF INFORMATION SYSTEMS*.
- Berke, A. (2017). How Safe Are Blockchains ? It Depends. *Harvard Business Review*.
- Bugembe, J. (2010). *Perceived Usefulness, Perceived Ease of Use, Attitude and Actual Usage of a New Financial Management System*. *MSC IN ACCOUNTING AND FINANCE OF MAKERERE UNIVERSITY*.
- Chen, P. Y., & Hitt, L. M. (2002). Measuring switching costs and the determinants of customer retention in internet-enabled businesses: A study of the online brokerage industry. *Information Systems Research*.
- Cheng, T. C. E., Lam, D. Y. C., & Yeung, A. C. L. (2006). Adoption of internet banking: An empirical study in Hong Kong. *Decision Support Systems*.
- Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*.
- Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: A Comparison of two Theoretical Models. *Management Science*.
- Davis, F. D., & Venkatesh, V. (1995). A critical assessment of potential measurement biases in the technology acceptance model: Three experiments. *International Journal of Human-Computer Studies*.
- Featherman, M. S., & Pavlou, P. A. (2002). Predicting e-Services Adoption: A Perceived Risk Facets Perspective. *International Journal of Human-Computer Studies*.
- Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*.
- Folkinshteyn, D., & Lennon, M. (2016). Braving Bitcoin: A technology acceptance model (TAM) analysis. *Journal of Information Technology Case and Application Research*.

- Gupta, V., & Knight, R. (2017). How Blockchain Could Help Emerging Markets Leap Ahead. *Harvard Business Review*.
- Hackett, R. (2017). Blockchain Mania. *Fortune*.
- Hancock, M., & Vaizey, E. (2016). Distributed Ledger Technology: beyond block chain. *UK Government Office for Science*.
- Heires, K. (2016). The Risks and Rewards of Blockchain Technology. Retrieved October 16, 2017, from <http://www.rmmagazine.com/2016/03/01/the-risks-and-rewards-of-blockchain-technology/>
- Hoser, T. (2016). *Blockchain Basics, Commercial Impacts and Governance Challenges*. *Governance Directions*.
- Igbaria, M., Iivari, J., & Maragahh, H. (1995). Why Do Individuals Use Computer Technology?: A Finnish Case Study. *Information and Management*.
- Kshetri, N. (2017). Will blockchain emerge as a tool to break the poverty chain in the global south? *Third World Quarterly*.
- Kumpajaya, A., & Dhewanto, W. (2015). THE ACCEPTANCE OF BITCOIN IN INDONESIA: EXTENDING TAM WITH IDT. *Journal of Business and Management*.
- Legris, P., Ingham, J., & Collerette, P. (2001). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*.
- Lindqvist, U., & Neumann, P. G. (2017). The Future of the Internet of Things. *Communications of the ACM*.
- Lowry, P., Gaskin, J., Twyman, N., Hammer, B., & Roberts, T. (2013). Taking “Fun and Games” Seriously: Proposing the Hedonic-Motivation System Adoption Model (HMSAM). *Journal of the Association for Information Systems*
- MacIver, K. (2016). From the internet of information to the internet of value. Retrieved September 29, 2017, from <http://www.i-cio.com/big-thinkers/don-tapscott/item/from-the-internet-of-information-to-the-internet-of-value>
- Marangunic, N., & Granic, A. (2015). Technology acceptance model: a literature review from 1986 to 2013. *UNIVERSAL ACCESS IN THE INFORMATION SOCIETY*.
- Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System.
- Ngyuen, B., & De Cremer, D. (2016). The Fairness Challenge of the Internet of Things. Retrieved October 10, 2017, from <http://www.europeanbusinessreview.com/the-fairness-challenge-of-the-internet-of-things/>
- Pavlou, P. A. (2003). Consumer Acceptance of Electronic Commerce: Integrating Trust and Risk with the Technology Acceptance Model. *International Journal of Electronic*

*Commerce.*

- Podsakoff, P. M., & Organ, D. W. (1986). Self-Reports in Organizational Research: Problems and Prospects. *Journal of Management*.
- Rahi, S., Ghani, M. A., & Alnaser, F. M. I. (2017). Predicting customer's intentions to use internet banking: the role of technology acceptance model (TAM) in e-banking. *Management Science Letters*.
- Ring, P. S., & Van De Ven, A. H. (1994). Developmental Processes of Cooperative Interorganizational Relationships. *Academy of Management Review*.
- Roy, S. K., & Kesharwani, A. (2012). The impact of trust and perceived risk on internet banking adoption in India : An extension of technology acceptance model. *International Journal of Bank Marketing*.
- Scherer, M., & Craddock, G. (2002). Matching Person & Technology (MPT) assessment process. *Technology and Disability*
- Sekaran, U. (2000). *Research methods for business. Research methods for business* (4th Editio). John Wiley & Sons, Inc.
- Shin, L. (2016). How The Blockchain Will Transform Everything From Banking To Government To Our Identities. Retrieved September 27, 2017, from <http://www.forbes.com/sites/laurashin/2016/05/26/how-the-blockchain-will-transform-everything-from-banking-to-government-to-our-identities/#6d8a47c065d9>
- Siba, K., Prakash, T., & Prakash, A. (2017). Blockchain: An Evolving Technology. *Global Journal of Enterprise Information System*.
- Stone, V. (2013) The LOKUS instrument, University at Buffalo - Center on Knowledge Translation for Technology Transfer
- Szajna, B. (1996). Empirical Evaluation of the Revised Technology Acceptance Model. *Management Science*.
- Tapscott, D., & Tapscott, A. (2016). *Blockchain Revolution - How the Technology Behind Bitcoin is Changing Money, Business and the World*.
- Tapscott, D., & Tapscott, A. (2017). How Blockchain Will Change Organizations. *MIT Sloan Management Review*.
- Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research*.
- Underwood, S. (2016). Blockchain Beyond Bitcoin. *Communications of the ACM*
- Valenzuela, J. (2015). Bitcoin Remittances to Mexico See Huge Potential. Retrieved October 30, 2017, from <https://cointelegraph.com/news/bitcoin-remittances-to-mexico-see-huge->

potential

Venkatesh, V. (2000). Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model. *Information System Research*.

Venkatesh, V., & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies. *Management Science*.

Yli-Huumo, J., Ko, D., Choi, S., Park, S., & Smolander, K. (2016). Where is current research on Blockchain technology? - A systematic review. *PLoS ONE*.

## **APPENDICES**

### **Appendix 1: Survey Design**

Please note, that this survey was only launched in English.

#### Start of Block: Introduction

INTRO WELCOME TO THE TECHNOLOGY ACCEPTANCE SURVEY FOR BLOCKCHAIN-BASED-APPLICATIONS (BBA)!

There's no right or wrong in this survey, but it is important that you finish all the questions.

Thank you for agreeing to take part in this important survey measuring your level of knowledge, perceived usefulness, risk and ease of use for the infamous Blockchain Technology. This questionnaire was conducted for the Master in Business Program at Católica Lisbon - School of Business & Economics.

In order to draw a picture of society's perception, we will be gaining your thoughts and opinions about several aspects of Blockchain.

This survey should only take between 6-8 minutes to complete. Be assured that all answers you provide will be kept in the strictest confidentiality.

Please click 'Next' to begin.

#### Start of Block: Demographics

D1 What is your gender?

Female (1)

Male (2)

D2 What is your age?

- Under 18 years old (1)
- 18-29 years old (2)
- 30-39 years old (3)
- 40-49 years old (4)
- 50-59 years old (5)
- 60 years and over (6)

D3 What is the highest level of education you have completed?

- Less than Highschool diploma (1)
- Highschool degree (2)
- Undergraduate degree (Bachelor or equivalent) (3)
- Postgraduate degree (Master or equivalent) (4)
- Professional degree (PhD or equivalent) (5)
- Other (6)

D4 What is your current employment status?

- Employed full-time (40 or more hours per week) (1)
- Employed part-time (up to 39 hours per week) (2)
- Student (3)
- Self-employed (4)
- Unemployed and currently looking for work (5)
- Retired (6)
- Unable to work (7)

D5 Which of the following categories best describes the industry you work in (regardless from your actual position)?

▼ Accounting (1) ... Don't work (37)

D6 Which of the following categories best describes your primary functional work area?

▼ Account Management (1) ... Don't work (23)

### Start of Block: Level of Knowledge

LK1 Have you ever heard about Blockchain technology?

Yes (1)

No (2)

*Skip To: End of Block If Have you ever heard about Blockchain technology? = No*

LK2 Does the following statement describe your current state of awareness, interest or use of Blockchain technology? If you think your knowledge level is higher than indicated, please answer with "No".

*"I had heard of Blockchain technology, but I have not tried to get more information about it."*

Yes (1)

No (3)

*Skip To: End of Block If Does the following statement describe your current state of awareness, interest or use of Blockch... = Yes*

LK3 Does the following statement describe your current state of awareness, interest or use of Blockchain technology? If you think your knowledge level is higher than indicated, please answer with "No".

*"I am seeking details on whether Blockchain technology could be useful or beneficial; however I have not decided yet."*

- Yes (1)
- No (3)

*Skip To: End of Block If Does the following statement describe your current state of awareness, interest or use of Blockch... = Yes*

LK4 Does the following statement describe your current state of awareness, interest or use of Blockchain technology? If you think your knowledge level is higher than indicated, please answer with "No".

*"I am expecting to use Blockchain technology in the future, but have not been involved yet."*

- Yes (1)
- No (2)

*Skip To: End of Block If Does the following statement describe your current state of awareness, interest or use of Blockch... = Yes*

LK5 Please specify your involvement in Blockchain technology.

- Trading with Crypto-Currencies (e.g. Bitcoin) (1)
- Buyer or seller on Blockchain based applications (2)
- Development of Blockchain applications (e.g. Coding) (3)
- Mining (4)
- Other (Please specify) (5) \_\_\_\_\_

Start of Block: Blockchain Information

Please note, this section was randomized, meaning that only half of the participants answering LK1 with 'No' were able to see this additional information

**INFO BEFORE ASKING YOU MORE QUESTIONS ABOUT BLOCKCHAIN, I PROVIDE A DESCRIPTION OF THE KEY ASPECTS:**

**The Problem.**

The Internet as we know it allows us to communicate, collaborate and connect online. Information can be viewed, extracted and exchanged, but when it comes to money we have to rely on third parties overlooking activities, like banks, notaries or other intermediaries (e.g. AirBnB, VISA, Paypal, Uber, etc.). These powerful intermediaries establish trust and connect parties, which naturally comes at an additional cost. This means that value is not only lost in transaction fees, but also in long and inefficient processes and limited trust. Personal information is collected and our online identities are often shared and monetized by influential intermediaries. The current online infrastructure was never designed to handle the exchange of actual value and this is what Blockchain can change for the better by offering a potentially faster, cheaper and more secure network design.

*“No term at present is more hyped, and more poorly understood”*  
(Hackett, 2017)

**What is a Blockchain?**

A Blockchain can be described as a decentralized database, or accounting system that keeps continuously updated digital records of who owns what. Blockchains are synchronized to the Internet and use a clever mix of cryptography and game theory in order to establish trust and securely transfer anything of value directly between two parties (Peer-to-Peer), without a need of trusted intermediaries. Blockchain networks can be private with restricted membership similar to an intranet, or public, like the Internet, accessible to any person in the world.

Encrypted data blocks are verified by the network and cryptographically chained together, holding a detailed and tamper-proof history of every transaction ever occurred. A block could represent data of many types - currency (e.g. Bitcoin), intellectual property (e.g. patents, arts, music), identity (birth certificate, driver's license), or property titles (e.g. land, buildings), to just name a few.

The most famous application so far is Bitcoin. Bitcoin can be seen as digital cash used for online payments independently from a central authority, establishing a Peer-to-Peer Electronic Cash System. However, the uses of Blockchain are endless. It can protect our personal data and property by using digital self-executing contracts, and give access to the 2 billion people excluded from financial services. Anything of value can be digitized and securely and instantly exchanged. It is expected to reduce financial fraud significantly as every transaction is verified by the consensus rather than central authorities.

Start of Block: Perceived Usefulness

PU Please indicate how likely or unlikely you perceive the following statements to be accurate.

(BBA = Blockchain-based Application)

	Extremely unlikely (2)	Unlikely (3)	Neutral (4)	Likely (5)	Extremely likely (8)
Using BBA's would enable me to accomplish my tasks more quickly. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using BBA's would improve my job performance. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using BBA's in my job would increase my productivity. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using BBA's would enhance my effectiveness on the job. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using BBA's would make it easier to do my job. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would find BBA's useful in my job. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Start of Block: Perceived Ease of Use

PEU Please indicate how likely or unlikely you perceive the following statements to be accurate.

(BBA = Blockchain-based Application)

	Extremely unlikely (1)	Unlikely (2)	Neutral (3)	Likely (4)	Extremely likely (5)
Learning how to operate with BBA's would be easy for me. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would find it easy to get BBA's to do what I want it to do. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My interactions with BBA's would be clear and understandable. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would find BBA's to be flexible to interact with. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It would be easy for me to become skillful at using BBA's. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would find BBA's easy to use. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Start of Block: Perceived Risk

PR Please indicate to what extent you agree or disagree with the following statements.

(BBA = Blockchain-based Application)

	Strongly disagree (7)	Somewhat disagree (5)	Neutral (4)	Somewhat agree (3)	Strongly agree (1)
When transferring money on BBA's, I am afraid that I will lose money due to careless mistakes such as wrong input of account number or wrong input of the amount of money. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
When transaction errors occur, I worry that I cannot get compensation for my loss. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
BBA's may not perform well because of technical errors in the network. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
BBA's may not perform well and process payments incorrectly. (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would not feel save providing personal or private information over BBA's. (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I'm worried to use BBA's because other people may be able to access my account. (13)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using BBA's would lead to a loss of convenience of me because I would have to waste a lot of time fixing payment errors. (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It would take me a lot of time to learn how to use BBA's. (12)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Start of Block: Intention to Use

IU Please indicate to what extent you agree or disagree with the following statements.

(BBA = Blockchain-based Application)

	Strongly disagree (7)	Somewhat disagree (5)	Neutral (4)	Somewhat agree (3)	Strongly agree (1)
It is desirable for me to learn how to use BBA's. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would use BBA's for my banking needs. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Using BBA's for transactions is something I would do. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would see myself using BBA's for handling my transactions. (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would feel comfortable to use BBA's. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Assuming I had access, I intend to use BBA's. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Appendix 2: SPSS Output – Demographic Statistics

### What is your gender?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Female	251	49,3	49,3	49,3
Male	258	50,7	50,7	100,0
Total	509	100,0	100,0	

### What is your age?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Under 18 years old	4	,8	,8	,8
18-29 years old	448	88,0	88,0	88,8
30-39 years old	47	9,2	9,2	98,0
40-49 years old	2	,4	,4	98,4
50-59 years old	7	1,4	1,4	99,8
60 years and over	1	,2	,2	100,0
Total	509	100,0	100,0	

**What is the highest level of education you have completed?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Less than Highschool diploma	2	,4	,4	,4
Highschool degree	167	32,8	32,8	33,2
Undergraduate degree (Bachelor or equivalent)	209	41,1	41,1	74,3
Postgraduate degree (Master or equivalent)	120	23,6	23,6	97,8
Professional degree (PhD or equivalent)	6	1,2	1,2	99,0
Other	5	1,0	1,0	100,0
Total	509	100,0	100,0	

**What is your current employment status?**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Employed full-time (40 or more hours per week)	114	22,4	22,4	22,4
Employed part-time (up to 39 hours per week)	24	4,7	4,7	27,1
Student	339	66,6	66,6	93,7
Self-employed	19	3,7	3,7	97,4
Unemployed and currently looking for work	9	1,8	1,8	99,2
Retired	3	,6	,6	99,8
Unable to work	1	,2	,2	100,0
Total	509	100,0	100,0	

**Appendix 3: SPSS Output – Level of Knowledge Descriptive Statistics**

**6 Levels of Knowledge**

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Non-Awareness	168	33,0	33,0	33,0
Non-Awareness (Info)	160	31,4	31,4	64,4
Awareness	74	14,5	14,5	79,0
Interest Orientation	52	10,2	10,2	89,2
Interest Preparation	32	6,3	6,3	95,5
Initial Use	23	4,5	4,5	100,0
Total	509	100,0	100,0	

## Appendix 4: SPSS Output – Reliability Analyses

### Perceived Ease of Use

#### Case Processing Summary

		N	%
Cases	Valid	509	100,0
	Excluded <sup>a</sup>	0	,0
	Total	509	100,0

a. Listwise deletion based on all variables in the procedure.

#### Reliability Statistics

Cronbach's Alpha	N of Items
,933	6

\*Cronbach Alpha PEU

#### RELIABILITY

```
/VARIABLES=PEU_1 PEU_2 PEU_3 PEU_4 PEU_5 PEU_6  
/SCALE('ALL VARIABLES') ALL  
/MODEL=ALPHA.
```

---

### Perceived Usefulness

#### Case Processing Summary

		N	%
Cases	Valid	509	100,0
	Excluded <sup>a</sup>	0	,0
	Total	509	100,0

a. Listwise deletion based on all variables in the procedure.

#### Reliability Statistics

Cronbach's Alpha	N of Items
,893	6

\*Cronbach Alpha PU

#### RELIABILITY

```
/VARIABLES=PU_1 PU_2 PU_3 PU_4 PU_5 PU_6  
/SCALE('ALL VARIABLES') ALL  
/MODEL=ALPHA.
```

---

## Perceived Risk

### Case Processing Summary

		N	%
Cases	Valid	509	100,0
	Excluded <sup>a</sup>	0	,0
	Total	509	100,0

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

Cronbach's Alpha	N of Items
,893	6

\*Cronbach Alpha PR\_REV

### RELIABILITY

```
/VARIABLES=PR_1 PR_2 PR_3 PR_4 PR_5 PR_6 PR_7 PR_8  
/SCALE('ALL VARIABLES') ALL  
/MODEL=ALPHA.
```

---

## Intention to Use

### Case Processing Summary

		N	%
Cases	Valid	509	100,0
	Excluded <sup>a</sup>	0	,0
	Total	509	100,0

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

Cronbach's Alpha	N of Items
,883	8

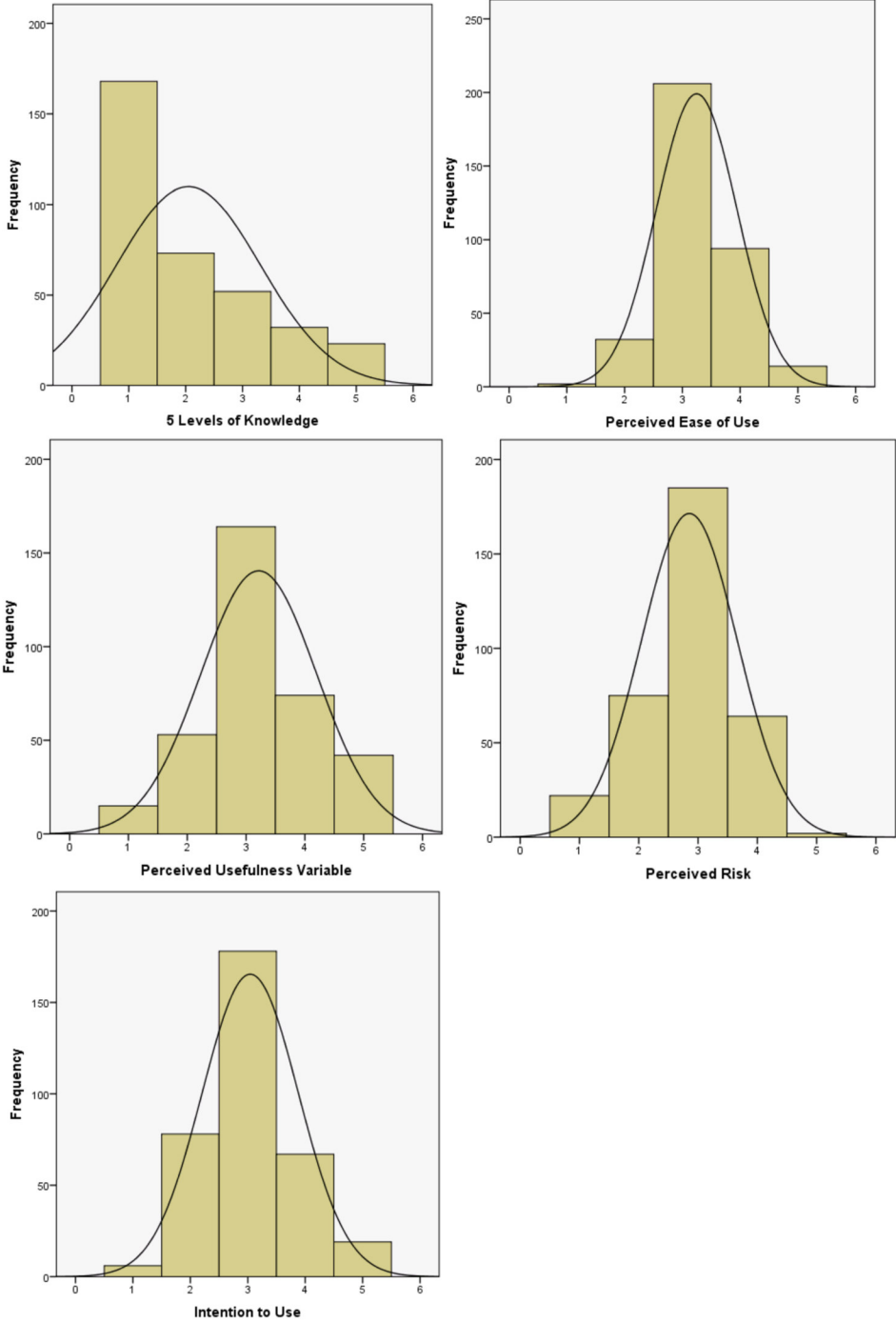
\*Cronbach Alpha IU

### RELIABILITY

```
/VARIABLES=IU_1 IU_2 IU_3 IU_4 IU_5 IU_6  
/SCALE('ALL VARIABLES') ALL  
/MODEL=ALPHA.
```

---

**Appendix 5: SPSS Output – Test of Normality**



		Level of Knowledge	Perceived Ease of Use	Perceived Usefulness	Perceived Risk	Intention to Use
N	Valid	349	349	349	349	349
	Missing	0	0	0	0	0
Skewness		,976	,236	,043	-,381	,301
Std. Error of Skewness		,131	,131	,131	,131	,131
Kurtosis		-,205	,589	-,162	,060	,118
Std. Error of Kurtosis		,261	,261	,261	,261	,261

## Appendix 6: SPSS Output – The Effect of LK on PR

### Variables Entered/Removed<sup>a</sup>

Model	Variables Entered	Variables Removed	Method
1	Level of Knowledge <sup>b</sup>	.	Enter

a. Dependent Variable: Perceived Risk

b. All requested variables entered.

### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,432 <sup>a</sup>	,187	,185	,731

a. Predictors: (Constant), Level of Knowledge

### ANOVA<sup>a</sup>

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	42,523	1	42,523	79,528	,000 <sup>b</sup>
	Residual	185,003	346	,535		
	Total	227,526	347			

a. Dependent Variable: Perceived Risk

b. Predictors: (Constant), Level of Knowledge

### Coefficients<sup>a</sup>

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3,421	,075		45,769	,000	3,274	3,568
	Level of Knowledge	-,277	,031	-,432	-8,918	,000	-,338	-,216

a. Dependent Variable: Perceived Risk

## Appendix 7: SPSS Output – The Effect of PR on IU

### Variables Entered/Removed<sup>a</sup>

Model	Variables Entered	Variables Removed	Method
1	Perceived Risk, Level of Knowledge <sup>b</sup>	.	Enter

a. Dependent Variable: Intention to Use

b. All requested variables entered.

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	,933 <sup>a</sup>	,870	,869	,304	,870	1153,292	2	345	,000

a. Predictors: (Constant), Perceived Risk, Level of Knowledge

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	212,560	2	106,280	1153,292	,000 <sup>b</sup>
	Residual	31,793	345	,092		
	Total	244,353	347			

a. Dependent Variable: Intention to Use

b. Predictors: (Constant), Perceived Risk, Level of Knowledge

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	5,712	,082		69,304	,000	5,550	5,874
	Level of Knowledge	,022	,014	,033	1,547	,123	-,006	,050
	Perceived Risk	-,951	,022	-,918	-42,616	,000	-,995	-,907

a. Dependent Variable: Intention to Use

**Appendix 8: SPSS Output – The Effect of LK on IU**

**Variables Entered/Removed<sup>a</sup>**

Model	Variables Entered	Variables Removed	Method
1	Level of Knowledge <sup>b</sup>	.	Enter

a. Dependent Variable: Intention to Use

b. All requested variables entered.

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,430 <sup>a</sup>	,185	,183	,759

a. Predictors: (Constant), Level of Knowledge

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	45,200	1	45,200	78,529	,000 <sup>b</sup>
	Residual	199,153	346	,576		
	Total	244,353	347			

a. Dependent Variable: Intention to Use

b. Predictors: (Constant), Level of Knowledge

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	2,458	,078		31,695	,000	2,305	2,610
	Level of Knowledge	,286	,032	,430	8,862	,000	,222	,349

a. Dependent Variable: Intention to Use

**Appendix 9: SPSS Output – The Effect of LK on PEU**

**Variables Entered/Removed<sup>a</sup>**

Model	Variables Entered	Variables Removed	Method
1	Level of Knowledge <sup>b</sup>	.	Enter

a. Dependent Variable: Perceived Ease of Use

b. All requested variables entered.

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,238 <sup>a</sup>	,057	,054	,678

a. Predictors: (Constant), Level of Knowledge

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	9,563	1	9,563	20,787	,000 <sup>b</sup>
	Residual	159,184	346	,460		
	Total	168,747	347			

a. Dependent Variable: Perceived Ease of Use

b. Predictors: (Constant), Level of Knowledge

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	2,978	,069		42,952	,000	2,842	3,114
	Level of Knowledge	,131	,029	,238	4,559	,000	,075	,188

a. Dependent Variable: Perceived Ease of Use

## Appendix 10: SPSS Output – The Effect of PEU on IU

**Variables Entered/Removed<sup>a</sup>**

Model	Variables Entered	Variables Removed	Method
1	Perceived Ease of Use, Level of Knowledge <sup>b</sup>		Enter

a. Dependent Variable: Intention to Use

b. All requested variables entered.

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,483 <sup>a</sup>	,234	,229	,737

a. Predictors: (Constant), Perceived Ease of Use, Level of Knowledge

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	57,089	2	28,544	52,587	,000 <sup>b</sup>
	Residual	187,265	345	,543		
	Total	244,353	347			

a. Dependent Variable: Intention to Use

b. Predictors: (Constant), Perceived Ease of Use, Level of Knowledge

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1,644	,190		8,676	,000	1,271	2,017
	Level of Knowledge	,250	,032	,376	7,749	,000	,186	,313
	Perceived Ease of Use	,273	,058	,227	4,680	,000	,158	,388

a. Dependent Variable: Intention to Use

## Appendix 11: SPSS Output – The Effect of LK on PU

**Variables Entered/Removed<sup>a</sup>**

Model	Variables Entered	Variables Removed	Method
1	Level of Knowledge <sup>b</sup>	.	Enter

a. Dependent Variable: Perceived Usefulness

b. All requested variables entered.

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,305 <sup>a</sup>	,093	,091	,942

a. Predictors: (Constant), Level of Knowledge

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	31,602	1	31,602	35,589	,000 <sup>b</sup>
	Residual	307,234	346	,888		
	Total	338,836	347			

a. Dependent Variable: Perceived Usefulness

b. Predictors: (Constant), Level of Knowledge

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	2,726	,096		28,304	,000	2,537	2,916
	Level of Knowledge	,239	,040	,305	5,966	,000	,160	,318

a. Dependent Variable: Perceived Usefulness

## Appendix 12: SPSS Output – The Effect of PU on IU

**Variables Entered/Removed<sup>a</sup>**

Model	Variables Entered	Variables Removed	Method
1	Perceived Usefulness, Level of Knowledge <sup>b</sup>	.	Enter

a. Dependent Variable: Intention to Use

b. All requested variables entered.

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,665 <sup>a</sup>	,442	,439	,629

a. Predictors: (Constant), Perceived Usefulness, Level of Knowledge

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	108,062	2	54,031	136,772	,000 <sup>b</sup>
	Residual	136,291	345	,395		
	Total	244,353	347			

a. Dependent Variable: Intention to Use

b. Predictors: (Constant), Perceived Usefulness, Level of Knowledge

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1,225	,117		10,470	,000	,995	1,455
	Level of Knowledge	,178	,028	,267	6,333	,000	,122	,233
	Perceived Usefulness	,452	,036	,533	12,615	,000	,382	,523

a. Dependent Variable: Intention to Use

**Appendix 13: SPSS Output – The Effect of PEU on PU**

**Variables Entered/Removed<sup>a</sup>**

Model	Variables Entered	Variables Removed	Method
1	Perceived Ease of Use, Level of Knowledge <sup>b</sup>		Enter

a. Dependent Variable: Perceived Usefulness

b. All requested variables entered.

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,480 <sup>a</sup>	,231	,226	,869

a. Predictors: (Constant), Perceived Ease of Use, Level of Knowledge

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	78,152	2	39,076	51,714	,000 <sup>b</sup>
	Residual	260,685	345	,756		
	Total	338,836	347			

a. Dependent Variable: Perceived Usefulness

b. Predictors: (Constant), Perceived Ease of Use, Level of Knowledge

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1,116	,224		4,991	,000	,676	1,556
	Level of Knowledge	,168	,038	,215	4,413	,000	,093	,243
	Perceived Ease of Use	,541	,069	,382	7,849	,000	,405	,676

a. Dependent Variable: Perceived Usefulness

**Appendix 14: SPSS Output – The Effect of Information on each Variable**

Perceived Ease of Use

**Variables Entered/Removed<sup>a</sup>**

Model	Variables Entered	Variables Removed	Method
1	Information <sup>b</sup>	.	Enter

a. Dependent Variable: Perceived Ease of Use

b. All requested variables entered.

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,125 <sup>a</sup>	,016	,013	,661

a. Predictors: (Constant), Information

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2,252	1	2,252	5,149	,024 <sup>b</sup>
	Residual	142,599	326	,437		
	Total	144,851	327			

a. Dependent Variable: Perceived Ease of Use

b. Predictors: (Constant), Information

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3,190	,051		62,526	,000	3,090	3,291
	Information	,166	,073	,125	2,269	,024	,022	,309

a. Dependent Variable: Perceived Ease of Use

## Perceived Usefulness

**Variables Entered/Removed<sup>a</sup>**

Model	Variables Entered	Variables Removed	Method
1	Information <sup>b</sup>		Enter

a. Dependent Variable: Perceived Usefulness

b. All requested variables entered.

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,085 <sup>a</sup>	,007	,004	,933

a. Predictors: (Constant), Information

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2,062	1	2,062	2,369	,125 <sup>b</sup>
	Residual	283,813	326	,871		
	Total	285,875	327			

a. Dependent Variable: Perceived Usefulness

b. Predictors: (Constant), Information

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3,048	,072		42,336	,000	2,906	3,189
	Information	,159	,103	,085	1,539	,125	-,044	,361

a. Dependent Variable: Perceived Usefulness

## Perceived Risk

### Variables Entered/Removed<sup>a</sup>

Model	Variables Entered	Variables Removed	Method
1	Information <sup>b</sup>	.	Enter

a. Dependent Variable: Perceived Risk

b. All requested variables entered.

### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,037 <sup>a</sup>	,001	-,002	,672

a. Predictors: (Constant), Information

### ANOVA<sup>a</sup>

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,198	1	,198	,438	,509 <sup>b</sup>
	Residual	147,165	326	,451		
	Total	147,363	327			

a. Dependent Variable: Perceived Risk

b. Predictors: (Constant), Information

### Coefficients<sup>a</sup>

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	3,107	,052		59,941	,000	3,005	3,209
	Information	,049	,074	,037	,662	,509	-,097	,195

a. Dependent Variable: Perceived Risk

## Intention to Use

### Variables Entered/Removed<sup>a</sup>

Model	Variables Entered	Variables Removed	Method
1	Information <sup>b</sup>	.	Enter

a. Dependent Variable: Intention to Use Variable

b. All requested variables entered.

### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,049 <sup>a</sup>	,002	-,001	,633

a. Predictors: (Constant), Information

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	,315	1	,315	,786	,376 <sup>b</sup>
	Residual	130,677	326	,401		
	Total	130,992	327			

a. Dependent Variable: Intention to Use Variable

b. Predictors: (Constant), Information

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	2,838	,049		58,096	,000	2,742	2,934
	Information	-,062	,070	-,049	-,887	,376	-,200	,076

a. Dependent Variable: Intention to Use Variable