The Impact of Perceived Sustainability on Blockchain Adoption in the Hospitality Industry

Bachelor Thesis for Obtaining the Degree

Bachelor of Business Administration in

Tourism, Hotel Management and Operations

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Affidavit

I hereby affirm that this Bachelor's Thesis represents my own written work and that I have used no sources and aids other than those indicated. All passages quoted from publications or paraphrased from these sources are properly cited and attributed.

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Abstract

Over the years blockchain has grown more mainstream. New applications in a variety of fields arise on a regular basis. With the rise of this technology, numerous innovative alternatives for its implementation, particularly in the hotel industry, are likely to evolve. In order to stay up-to-date and hence profitable, many firms and industries are seeking to adapt or improve their present procedures with the help of innovation. For instance, the ability to make necessary alterations and upgrades in order to meet the rapidly growing demands is critical hospitality. The way customers perceive businesses performance has a direct influence on their motivation to pay for the services. This does not only include innovation and adaptation of new technologies. Another important topic for hospitality is sustainable development. Every year more guests pay attention to the trending social and environmental issues and how well hotels are able to integrate potential solutions to the pending problems. Blockchain possesses a number of distinct characteristics that have yet to be incorporated into any current distributed system. These technical features have already proven to have a great potential in a variety of areas, specifically when it comes to ensuring sustainable development.

This thesis aims to contribute to the ongoing discussion over the hotel industry's long-term sustainability. For a successful adoption of blockchain in hospitality, it is necessary to examine the potential impact on hotels as a whole, along with particular departments within them. Another important discussion is customers' willingness to start utilizing a blockchain-operated platform. The results have concluded that it is important to spread awareness on the topic as familiarity with the technology was empirically proven to have a significant impact on the willingness to switch. This calls not only for a further research on the topic but for a continues development of the technology in an attempt to resolve its pending issues and raise its popularity within the mass public.

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1 Introduction

The former perspective of data collecting and dissemination has changed when blockchain technology was brought to the world in 2008 by a team of researchers using the pseudonym Satoshi Nakamoto (Nakamoto, 2008). Blockchain has a number of unique qualities that have yet to be implemented into any existing distributed system (Treiblmaier, 2020). These technological characteristics have already demonstrated tremendous potential in several parts of life. According to recent research, blockchain technology can be relevant to a variety of businesses (Thees et al., 2020). Originally, the technology was intended to be utilized by a range of financial organizations. Scientists concluded that blockchain might be used in any non-financial business that involves data collection and processing, such as supply chains, health-care systems, licensing, and others (ibid). On the subject, analysts and business professionals have different viewpoints. Despite a popular opinion that Distributed Ledger Technologies are disruptive to the environment and present economy, many enthusiasts believe that it will revolutionize data storage and its distribution. Blockchain is considered as a basis of the future Chinese economy. For instance, 51 percent of Chinese enterprises have a blockchain-related plan (Valeri & Baggio, 2020). However, cryptocurrencies continue to be probably one of the best known and widely used implementations at this moment (Chuen, 2015).

Human connection is crucial for the hospitality industry. Its success is impacted by the level of the services offered and, as a result, by client happiness. This industry is said to be amongst the world's largest job producers (Buhalis et al., 2011). Hospitality has a complicated organization with many different departments, ranging from value chain to front-desk services that have a direct contact with customers (Lickorish & Jenkins, 2007). As a result, each change in one sphere generates a snowball effect of remodeling of other parts of the industry.

Ever since the birth of the internet, hospitality has seen significant changes (Treiblmaier, 2020). From Booking.com, which allows its users make a reservation from their couch, to virtual reality that is slowly transforming the way people used to travel - the internet and technology have become the most commonly used and thus

the most principal ways of researching information when talking about tourism (Buhalis et al., 2011). As many others, hospitality industry majorly relies on demand. The tourism sector is always undergoing transformation in order to stay current and match consumer demands by simplifying and improving guests' experiences. Clients already use basic everyday gadgets to perform simple operations like browsing, booking, payments, providing feedback, and expressing their opinions, as these are the technologies that help them save time in the modern fast-paced lifestyle. The rise of social media has already had a significant impact on the tourist business. (Chuang et al., 2017). In addition to the well-known interpersonal exchange of experiences, guests can now create a simple Facebook post that is seen by millions. A bad tweet may effectively harm company's image and push it dangerously close to bankruptcy. The capacity to comprehend and swiftly implement new technologies is now a defining factor in the performance of the hospitality sector agents (Chuang et al., 2017).

It needs to be noted that the tourism industry is highly dependent on individual services thus when talking about various applications of blockchain one must consider all the possible corresponding sectors and departments that are connected to hospitality (Thees et al., 2020). As a result, it is critical to recognize that while discussing structural changes and the adoption of new technologies, there are several players and sectors involved (Lickorish & Jenkins, 2007). Tourism refers to a complex network of businesses and individuals with varying levels of income and experience (ibid). The best strategies to adapt DLT to a change-resistant industry have been researched. As a result, it's critical not only to grasp prospective consumers' habits and patterns, but also to strive to implement technology gradually but consistently until it can be fully accepted (Lund et al., 2019).

With the implementation of Online Travel Agencies (OTA) and Global Distribution Systems (GDS) many smaller travel agencies aim to become part of such in order to stay competitive. According to HOTREC (2020), in Europe in 2019 Booking.com controls more than two thirds of the market. This has led to a situation where hotel prices are mainly set not by the hotels themselves but by the intermediary websites that serve as a platform where the customer can connect with the business of choice.

Not only are hotels obligated to choose between various distribution channels in order to offer their services due to the fact that their own marketing strategy is most of time slow and not strong enough to compete with the one offered by the leading travel agencies but also, they lose a sufficient amount of profit as a commission to these companies (Tekin Bilbil, 2019). One of the three research propositions suggested by Önder & Treiblmaier (2018) is the disintermediation of the tourism industry caused by the blockchain system. Particularly, in the article it is argued that the introduction of this technology will be the so-called second wave of disintermediation, the first one being the previously discussed invention of the World Wide Web and the rise of popularity of the OTAs (ibid). Due to the amount of applications that the blockchain technology has and the complexity and variety of services and different departments that tourism has to offer, it is difficult to discard the ones that are not particularly applicable to the hospitality industry (Treiblmaier, 2020). There is, however, already evidence that the blockchain technology can be successfully implemented in the sector and replace the well-known online travel agencies. Currently these platforms are still in the experimental state, but with a higher market exposure and after a thorough research on this topic, they have a possibility to become the new future of the way customers interact with the industry.

1.1 Practical Relevance

Despite the extensive media coverage, the novelty of blockchain means that there are little scientific studies on the subject (Önder & Treiblmaier, 2018). The vast majority of studies focus on cryptocurrencies instead of the infrastructure that sustains them. The full potential of blockchain is yet to be discovered as it has an increasing variety of use cases (Thees et al., 2020). As a result of the existing lack of relevant evidence, several study proposals have been made, particularly into the consequences and effects of deploying blockchain (Önder & Treiblmaier, 2018).

Numerous businesses and sectors are attempting to adapt their processes or change their existing processes in order to stay current and hence successful. For example, hospitality relies heavily on the capacity to make essential adjustments and upgrades in order to satisfy client's needs. As a result, many features of the blockchain

technology must be implemented; otherwise, the tourist sector risks being pushed to the outside of technological advancement. The goal of this study is to figure out how blockchain may be used to create a new, long-term solution for the hospitality industry. Furthermore, it is critical to anticipate probable losses and develop the best and most lucrative adaption strategies.

This thesis attempts to add to the continuing conversation about the hotel industry's sustainable growth. The significance of blockchain technology in regard to tourism is explored in this paper. It suggests techniques for implementing the technology without creating a complete industrial reorganization. The research is undertaken through the lens of blockchain as a new option to make tourism more sustainable in the long and medium term. If blockchain adoption in these sectors is successful, it will be required to assess the possibility of an influence on the organizations in general, as well as specific units within them. The reaction of present and future clients will also be an important outcome of the adoption. Any use of sustainable technology has always had an impact on customer happiness and also the business's costs and profits. As a result, using blockchain in hotel industry will have both good and negative implications. The goal of this study is to determine whether the benefits of the new system outweigh the disadvantages.

1.2 Aim of Research

In this research I aim to gain a better understanding of the applicability of blockchain to the tourism and hospitality industry. First of all, a literature review will be used to analyze and to specify the current and the perspective ways the technology can be applied to the industry in question. The following will be used as a foundation for discussing the potential advantages and disadvantages of the mentioned implementations as well as the innovation as a whole in order to answer the first two and the main research questions of this thesis.

RQ1a:

What are the main areas of concern of adapting blockchain in the hospitality industry?

RQ1b:

What are the main areas of major opportunities of adapting blockchain in the hospitality industry?

To be able to analyze these questions a number of hypotheses are to be formed, which are based on the previous research on the topic. For the reasons of clarity of the thesis and to determine specific areas of concern and possibilities, the presumptions will be differentiated according to the three pillars of sustainability. I believe such separation will facilitate not only the discussion and investigation of the results of the research, but also create a clear understanding for the survey participants about the discussed impact of blockchain on sustainability of the hospitality industry. This survey also aims to provide insights to customer perception about blockchain and to respond to the second research question of this thesis, namely:

RQ2:

How willing are customers to participate in helping the industry adapt and utilize the technology?

Customer satisfaction plays a critical role in every business and especially when it comes to the tourism and hospitality industry. The way guests perceive the innovation will have a direct impact on their willingness to purchase the offered service and hence the profitability of the company. In order to answer this question, it is important to look at its different aspects:

- Advantages of implementing DLT in the industry
- Disadvantages of implementing DLT in the industry
- Willingness to join and participate in the innovation and its adaptation

These categories will be the foundation of the survey. Hence, the research questions address not only the concerns and opportunities of the technology according to researchers and companies who are willing to participate in the implementations, but also its direct impact on the customer and their opinion on the matter.

2 Literature Review

2.1 Blockchain Technology

As it falls within the wide definition of all developments that are utilized to assign data to numerous places, blockchain is also known as distributed ledger technology (DLT) (Treiblmaier, 2018). The idea behind the invention is that rather than a centralized computer that controls the entire program, blockchain technology operates without a main authority and produces the same result when accessed from different devices. This feature is called decentralization (Hirsh & Alman, 2020). The term "blockchain" refers to a system, which is composed of various blocks that store data and are linked together via a chain. The structure may be compared to a net, with each block also containing the details of an operation so that the technology can verify whether or not an activity is genuine (Chuen, 2015). Every transaction has a hash is a unique identifier made up of a combination of characters that aids the software in encrypting the content. This helps to prevent duplicate payment scenarios that are typical in other forms of online transactions (Hirsh & Alman, 2020). The encryption procedure uses a prime number to confirm its authenticity. Such process grows more difficult each year, since the larger the number, the more sophisticated and energy-intensive the operation becomes. Mining is the practice of locating prime numbers for use in technology. It is carried out via a machine that devotes its processing power to running the algorithm. Miners are then paid a fixed quantity of cryptocurrency (Chuen, 2015).

Today, IT companies are primarily concerned with obtaining personal data and reselling it to other enterprises. Those that hold this data gain advantage in deciding what information reaches end-consumers. As a result, decentralization of blockchain might be viewed as a novel solution to addressing neoliberalism and consumerism. Immutability, Transparency, Programmability, Decentralization, Anonymity, and Consensus are also some of the useful characteristics that blockchain has to offer. So far, the technology has proven to be one of the most secure ones of its kind (Treiblmaier, 2020).

Nowadays, DLT blockchain has a limited amount of applicants because the technology is still in the development phase (Hirsh & Alman, 2020). It was initially meant to be used for monetary operations (Nakamoto, 2008).The main motivation was to reduce transaction fees, that are steadily rising due to rising labor expenses (Nakamoto, 2008). As a result, the software that powers cryptocurrency is presently the most prevalent and well-known application of blockchain (Chuen, 2015). Currently, eCash is a point of interest of a growing number of investors. The total estimated number of cryptocurrencies circulating in 2020, according to CoinMarketCap (2020), is 6,955, with a total market valuation of $324.716 billion. Bitcoin was the first and, as a result, is one of the most well-known cryptocurrencies in the world.

Based on the recent experiments and the amounts of investments and research on this topic it is expected that the implementation of this technology is not only possible, but that it will also benefit the society. In the following sections various use cases in hospitality and tourism will be discussed through a sustainability prism, permitting a thorough analysis of how beneficial the application of blockchain technology would be to society.

2.2 Sustainable Implementation

There are two primary viewpoints on sustainability nowadays. The first one, which is called Triple bottom line (TBL), was first mentioned by Elkington J. in 1994 (Elkington, 2004). This model describes sustainability as a combination of issues and goals in the three aspects: environment, society, and economy (Treiblmaier, 2019). The Triple Bottom Line Model in Sustainability is depicted in Figure 2 below. The three circles each represent one of the three areas of concern addressed by the notion (environment, society, or economics), and their crossing represents point of conscious existence (Braccini & Margherita, 2018).This approach is widely discussed by researchers and is the most well-known representation of the current sustainable goals.

Figure 1. Triple-Bottom-Line Sustainability Model (based on [Braccini & Margherita, 2018]).

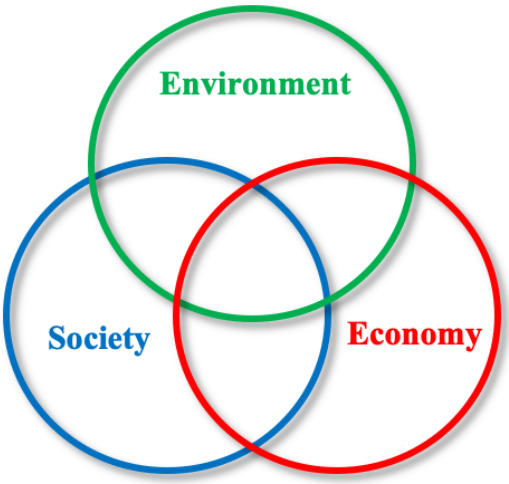
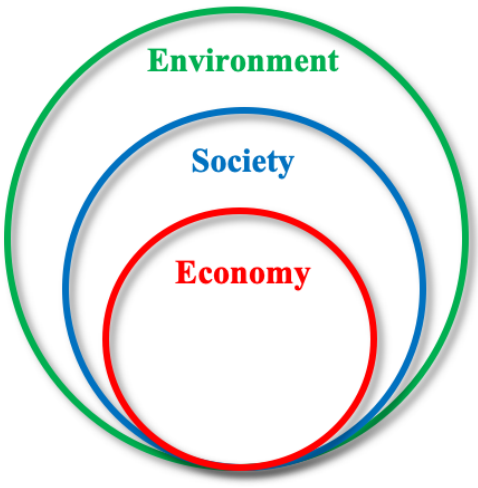


Figure 3 (below) depicts a more advance theory which focuses primarily on ecological challenges and accepts solutions to the other two areas of concern only if environmental targets are met. As a result, economic development is only significant when the earth is not in danger and society is well-functioning (Willard, 2012).This Three-Nested-Dependencies model was first suggested by Doppelt in his book "The Power of Sustainable Thinking" in 2008 (Doppelt, 2008).

Figure 2. Three Nested Dependencies Sustainability Model (based on [Willard, 2012]).



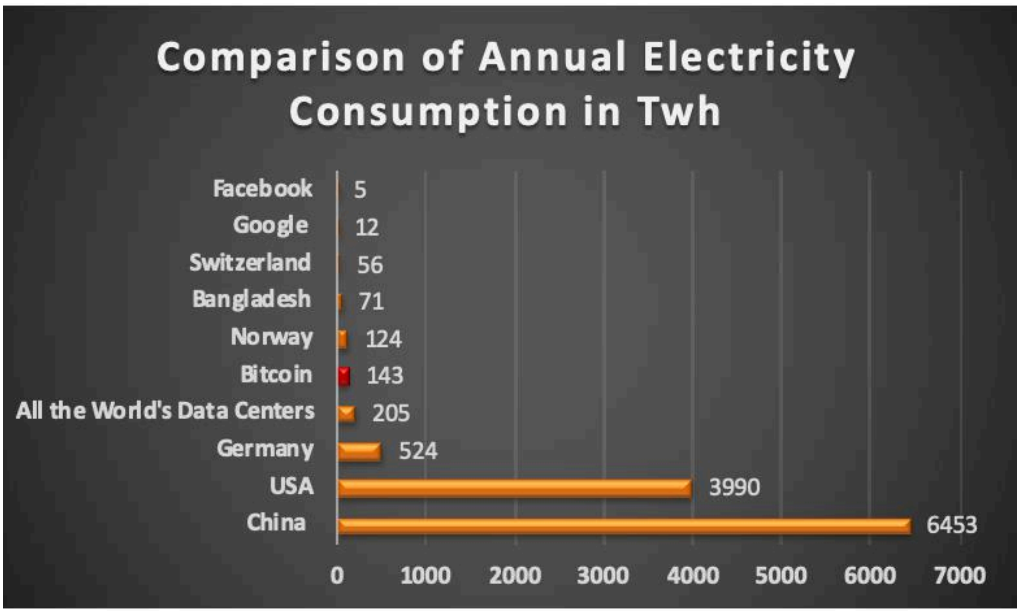
With the advancement of the concept, it became obvious that, in light of humanity's growing ecological destruction, it is critical to consider the realization of sustainability goals in context of the environment, focusing on the Three-Nested-Dependencies Sustainability Model. In this thesis I adopt a similar strategy when talking about the implementation of blockchain: it is important to start the discussion with determining the current environmental damage caused by the technology and whether the situation can be improved before proceeding with any further development.

In the following sections advantages and disadvantages of blockchain in general and more specifically in the tourism and hospitality industry are to be discussed through the prism of the three areas of concern in sustainability. Each part is then summarized and the main findings can be found in a table at the end of each sections. These results will be used as a basis for deriving hypotheses and creating a survey later on.

2.2.1 Environmental benefits and challenges

If one considers blockchain as a better solution to the present systems, it is crucial to remember that the very existence of blockchain necessitates growing quantities of computer power and energy, both of which have a detrimental effect on the environment. According to Truby (2018) blockchain technology has a significant contribution towards environmental pollution. The author claims that the energy required for a single bitcoin operation could support a British household for one full month. This amount of computational power exponentially grows after each transaction, which clearly rises a question whether DLT would be as sustainable as they strive to be. Additionally, as represented in Figure 2, McCarthy (2021) claims that bitcoin's annual electricity usage exceeds the yearly consumption of various countries like Norway, Bangladesh, Switzerland etc. This number for bitcoin is also significantly higher than that of the largest tech companies in the world (ibid).

Figure 3. Comparison of Annual Electricity Consumption in TWh (based on [McCarthy, 2021]).



A number of researchers are currently working on a so-called decarbonization of blockchain which aims to convert this energy-consuming invention into an environmentally friendly alternative (McCarthy, 2021). An attempt to tackle the problem and to motivate specialists come up with greener solutions is made by governments and a variety of conventions by enforcing taxation on holding cryptocurrencies. Such regulations are justified because value tokens, such as bitcoin and altcoins, are treated as monetary exchange units which categorizes them as digital money. For example, according to Andrew (2021) numerous major international companies accept payment with bitcoin. In 2014 Microsoft became one of the pioneers by offering their digital content in exchange for cryptocurrency (ibid).

Another threat that blockchain technology poses is that it establishes motivation for future inventions to become detrimental to the environment due to the lack of previous interventions (Truby, 2018). There is however, so far, no united strategy when it comes to decarbonizing the technology behind cryptocurrencies. The knowledge about the amounts of added pollution that the invention of blockchain has brought upon the environment has only recently gained attention within researchers and in the media. Such lack of information about the carbon footprint of the

technology is closely related to the absence of current taxation policies related to the caused ecological damage as it usually is the case with other industries and technologies (ibid). This can also be claimed to be one of the reasons why various governments prefer to restrict or even ban cryptocurrencies due to the inexistence of clear regulations and strategies to prevent their environmental harm. When talking about energy consumption, it is however important to compare data from various financial systems. For instance, Table 2 below represents the contrast between the environmental costs of Bitcoin and other tangible currencies.

Table 1. Environmental Costs (based on [Giungato et al., 2017]).

Currency	PJ / y
Bitcoin	3.97
Paper currency and minting	39.6
Gold mining	475
Gold recycling	25
Banking system	2340

It is clear that when compared to other known ways of conducting a transaction, bitcoin and generally blockchain consumes significantly less Joule per year. This number is nearly 10 times smaller than the environmental cost of fiat money (Mc Cook in Guingato et al., 2017). According to Mc Cook, such difference indicates blockchain's superiority when talking about the most environmentally friendly currency yet to exist. Isolated, cryptocurrency and related technology can be accused of having a horrific ecological impact, however, compared to the currently available alternatives, it is one of the most sustainable solutions currently available to humanity. Hence, researchers agree that it is yet not fully clear whether blockchain is sustainable. It is nevertheless expected that the increasing demand on the technology is likely to provoke a more extensive inquiry on the topic, thus triggering developers advance the existing system into a more sustainable alternative (ibid). The claims from the

previously discussed research dates back to the early stages of blockchain development. Since then there have been significant improvements when it comes to the technology. Like that, the biggest and most well-known blockchain that processes smart contracts, namely Ethereum, has overcome variety of significant modifications and updates in order to improve the existing problems of scalability and sustainability. Most recently the inventors released their plan Ethereum 2.0, which focuses on advancing speed and efficiency of the network. Its novelty is the switch from proof-of-work to a more advanced proof-of stake model. In such systems to validate transactions miners are chosen by their holding power, which decreases their amount and, thus, blockchain's carbon footprint. Such improvement will make Ethereum blockchain much more energy efficient (Investment Thesis, 2021).

Except for the obvious use in the field of finance, one of the sectors which is one of the main areas of application of blockchain is supply chain (Treiblmaier, 2020). Their designs are usually private, meaning that only a limited number of actors has access keys for obvious security reasons. The data about the transported goods is entirely traced by a program, which is activated after both parties have signed a corresponding smart contract. In this case the trackable properties of the item are its nature, ownership, quantity, quality and most importantly its location. From the customers point of view, an open blockchain system ensures that the products are manufactured in an environmentally friendly way, what can be a motivation for a purchase decision. For enterprises in the hospitality industry, such approach also removes not only the need for intermediates who operate the supply chain, but also multiple quality controls due to the transparency of the network, which except for the cost reduction also leads to a significant decrease in business waste due to the limitation of the spent resources. Moreover, the openness of the suggested technology allows for a clear record of ecological footprint of the process. There are various examples of large existing companies who have also joined the initiative and implemented the technology in their day-to-day operations. For instance, various established airlines, such as KLM (Royal Dutch Airlines), Air France and Singapore Airlines developed an DLT-based system for tracking different assets, such as spare parts and luggage. Not only that, but they also use smart contracts for crew and passenger identification as

well as with other parties in the supply chain (International Air Transport Association (IATA), 2018).

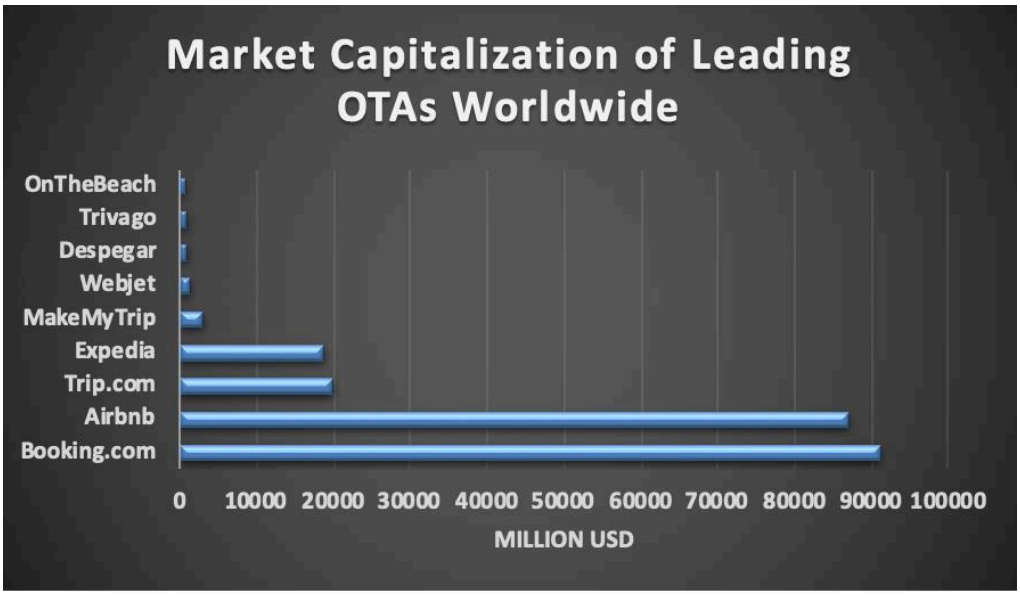
Another motivation for businesses in hospitality to become less environmentally damaging is recycling tokenization. Financial rewards in a form of cryptocurrency have already proven their worth in Northern Europe, where consumers are digitally paid for cautiously disposing their garbage. This idea can be possibly scaled to a number of companies and together with blockchain's ability to trace industrial waste it will create an efficient and encouraging method of recycling (ibid).

2.2.2 Societal benefits and challenges

Historically new technologies have proven to be somewhat unethical, while overall socially beneficial. This could also be the case with blockchain as it introduces a number of challenges despite offering a variety of benefits. Due to globalization and a rapid development of the distribution networks, it became difficult to avoid various risks and malfunctions. For instance, such issues as fraud, corruption, trust shortage, inefficiencies or attacks are hardly manageable with current tracking and risk aversion strategies, hence traceability and transparency have become an essential feature required for future development. Additionally, the fact that such systems are highly centralized makes them particularly vulnerable as a misfunction of one element leads to the collapse of the whole structure.

Social sustainability of blockchain is still being debated. In particular, in businesses that are heavily reliant on individuals and their demands, it is critical to carefully balance the consequence of each minor change in order to avoid significant loss. Tekin Bilbil (2019) conducted a survey where hoteliers were asked to name daily struggles they experience in the current system. The necessity of OTA puts hotel owners in a position where they are obligated to follow the predefined procedures. For instance, there is currently no such online or offline travel agency worldwide, which would rank close to Airbnb and Booking.com when it comes to market capitalization as of December 2020 (Figure 4).

Figure 4. Market Capitalization of Leading OTAs Worldwide (based on [Statista Research Department, 2021]).



The policies that smaller hotels have to follow include price parity, that is ensured by the "Best Price Guarantee" option implies that the business will have to accept a lower price. Such influence of only a few companies on the whole tourism industry has brought up a need of disintermediation of the booking systems (Önder & Treiblmaier, 2018). Luckily, DLT offers plenty of use cases that are able to transform the current practices into the ones which are not only easier, faster and more accessible but also sustainable (Saberi et al., 2019).

One of the major applications possibilities of blockchain that researchers agree on is identity management. Such combined characteristics of the technology as immutability and verifiability create a system where specific identification data is linked to one persona and it can be easily validated without a threat of being accessed or altered by an unauthorized authority. With proper management such invention has already proven to be socially beneficial. The shift, however, would not be possible without trust in the system and the trading partner, which was previously secured by the fee-demanding OTAs and GDSs. Hence, the system replacement is expected not only to be cost-saving but also reliable and trustworthy (Treiblmaier, 2020). One of the examples is the New York City's organization "Blockchain for change" which relies

on its distributed identification network for homeless people in order to provide them with access to various programs and services (Lapointe & Fishbane, 2019). Obviously, such use-case enlarged to a pool of every person on the planet raises two main concerns: scalability and privacy. As discussed before, blockchain's ability to expand and manage a large amount of transactions per second is still in a state of continuous improvement. There are already various models being developed to introduce the technology to the public. When it comes to privacy issues, various agents have concerns about their data being properly secured. Indeed, lack of proper regulations can lead to over-transparent records in the network, however, appropriate management ensures that DLT provides private and secure records and only to those who are certified to access such. Not only that, but a blockchain-based governance structure aims to transfer the control over personal information back to its owner, who will hence regain the right to decide when to share it, thus restoring the anonymity and, most importantly, democracy. Additionally, a decentralized system removes all the links between agents making it impossible for data brokers to collect user data based on connections and similarities, as it is currently the case on the internet (Lapointe & Fishbane, 2019).

Identity management, however, could be applied to smaller parts of an industry. Typically, the physical or current digital information storages pass through a number of agents on a daily basis, which clearly raises a risk of data leakage or identity theft that are a very common problem in tourism. If an identity is handled via a blockchain network, a traveler only provides the required information to a hospitality agent and the data is automatically verified, eliminating, for example, the need for the hotel to pass personal information of the guest to police or a corresponding authority upon their arrival (Treiblmaier, 2020). Such validation can be also implemented in order to improve the credibility of online customer reviews. These are a crucial part of any tourism related business as they act as a massive booster of the word-of-mouth and their certification can relive hotels form an inaccurate anonymous spam (ibid).

Traceability of blockchain facilitates tracking of the travelers' personal belongings while providing item's current location and status. Similarly, every other asset can be tracked via DLT: from inventory pieces, important to the hotel, to available guest

rooms (Treiblmaier, 2020). Its immutability, on the other hand, has a great contribution towards social sustainability of supply chain. Since only a majority of the network users are able to authorize and implement changes, it makes blockchains immune to corrupt agents, who try to unfairly act at an expense of others. Likewise, a transparent record of a product life cycle helps buyers make their purchase decision and avoid dishonest suppliers. Thus, DLTs help the society achieve its sustainable goals by ensuring fair and ethical trade (Saberi et al., 2019).

Disintermediation, however, has one clear detrimental impact on the social side of sustainability. A working space is eliminated when a third party or a middle person is removed. Currently, supply chains and other businesses rely heavily on human labor. Automating such jobs might result in a failure of certain long-term goals in the pursuit of others. Investment in re-education and repurposing of intermediary staff is necessary to avoid exacerbating the existing socioeconomic crisis. Due to the fact that even the basics of blockchain can be difficult to comprehend, informative strategies should be prioritized so as to ensure users about the trustworthiness of the network (Swan, 2017).

2.2.3 Economic benefits and challenges

As previously discussed, finance is one of the main areas of blockchain applications. DLT makes third party unnecessary, which has a significant positive effect on the transaction prices. Similarly, smart contracts permit participants to conduct negotiations automatically. Implementation of blockchain in the hospitality industry will assist in removing the middleman when it comes to the tourism supply chain. Such disintermediation can be claimed to be exactly addressing the current disadvantages of the OTA platforms as it enables hoteliers set their own prices, but also the reduced commission will boost business profits and customer's purchasing power (Treiblmaier, 2020). With lower fees hotels will be able to focus on their tailored marketing programs and personal plans. An example of a startup is Winding Tree – a non-profit private company based on the Ethereum platform. Its founders Maxim Izmaylov and Pedro Renaud Anderson claim that the system provides an opportunity for visitors and hoteliers to conduct smart contracts without being charged the transaction fee

by the company. The only accruing cost in this case will be the rate paid to stimulate miners, who offer their computer power to the network. Authors claim that this solves the problem of double marginalization, namely the weakened competitiveness due to the number of middlemen on different levels of the tourism supply chain. Additional savings are also enabled by avoiding multiple back and forth currency conversions with the help of blockchain (Maksim Izmaylov et al., 2018).

Lower labor and transportation costs are also expected when the existing levels of information processing are reduced (Lund et al., 2019). This idea is supported by a recent use case of implementing blockchain into International Business Machines Corporation (IBM) for the purpose of management of seafood containers. As a result, the company reported billions in logistic savings due to dependability and reliability of the tracking data (Saberi et al., 2019). However, despite the significantly reduced costs such systems still require funding: not only for transactions but also for the overall development and support of the technology. Many researchers and already existing prototypes offer a solution through tokenization. This means protocol and risk pool tokens that are incorporated into blockchain by making them crucial for the use of the platform and which are also designed to protect the network from being duplicated or. Last but not least, these tokens serve as an insurance for both parties delivering their obligation. This implies that the system either rewards the service provider for completing their part of the deal or reduces their number of tokens as a punishment for not doing their job. These reimbursement tokens are further delivered to the victimized customer (Etherisc, 2017).

DLTs also offer fast and cheaper currency exchange, which will save companies a great amount of money (Saberi et al., 2019). Except for facilitating financial operations, blockchain also enables businesses to economize when it comes to inventory management. Not only can the system automatically keep track of available hotel rooms but also record equipment and transmit this data within stake- and shareholders (Treiblmaier, 2020). An Ethereum based system called Etherisc has issued the first decentralized travel insurance, where the system automatically tracks any flight delays and immediately refunds its customers when such event occurs.

These systems use geolocation and live tracking in order to verify the eligibility of the refund claim (Etherisc, 2017).

Such implementations can be beneficial for both hotels and businesses as well as for their customers. Blockchain provides an updated decentralized data storage opportunity for an enterprise by keeping track of all the tickets and reservations, hence solving the problem of black-marketing by simply connecting customers' wallets to their corresponding purchase with an intention of proving the original ownership (Treiblmaier, 2020). Another benefit of implementing DLT into hospitality that can be directly noticeable to the client is tokenization of the loyalty programs. These can be used by hotels or by any other related businesses. Currently there is a lot of unclarity when it comes to the collectable bonus points, namely majority of them are overly complicated and customers end up never using them. Moreover, there are only a few collaborating companies whose points can be redeemed for different purposes. With blockchain there is a possibility to establish a connection between various programs as well as a trade of such loyalty tokens within users. A clear and accessible structure of personal benefits is also expected to provide additional boost to the marketing campaigns of the participating enterprises (ibid). An example of such a tokenization strategy already exists: Loyyal.com is currently offering a united way for their clients to accumulate and utilize points within organizations that are a part of their blockchain (Önder & Gunter, 2020). What is more, similar tokens can be offered to employees instead or in addition to their incentives. It can be highly beneficial as it gives workers an opportunity to tailor their company benefits according to their personal taste (Treiblmaier, 2020).

Majority of previously mentioned implementations are not possible without further supportive policies. A system of effective governmental laws and regulations has to be developed in an attempt to tackle the issue of money laundering, corruption and other illegal activities. There is at this time no united strategy of how to perceive cryptocurrencies and their base-network for the authorities to be able to agree on a unanimous plan for action (Swan, 2017). On a lower scale, businesses are also in need for accompanying supportive policies so as to ensure a better and smoother implementation and further utilization (Swan, 2017).

3 Methodology

3.1 Quantitative Research Design

In the thesis I am to address the two main questions of the research, namely: what are the main areas of concern and the major opportunities of adapting blockchain in the tourism and hospitality industry and whether customers view blockchain as a positive innovation and how willing are they to participate in helping the industry adapt and utilize the technology. For these purposes it is appropriate to use a quantitative method. Primary data will be collected with the help of a survey which will be specifically discussed in the following sections. This thesis takes a quantitative research approach aiming to understand respondents' attitude towards the blockchain technology in hospitality by investigating possible correlations between the predefined indicators. The study will examine such constructs as blockchain, sustainability and hospitality.

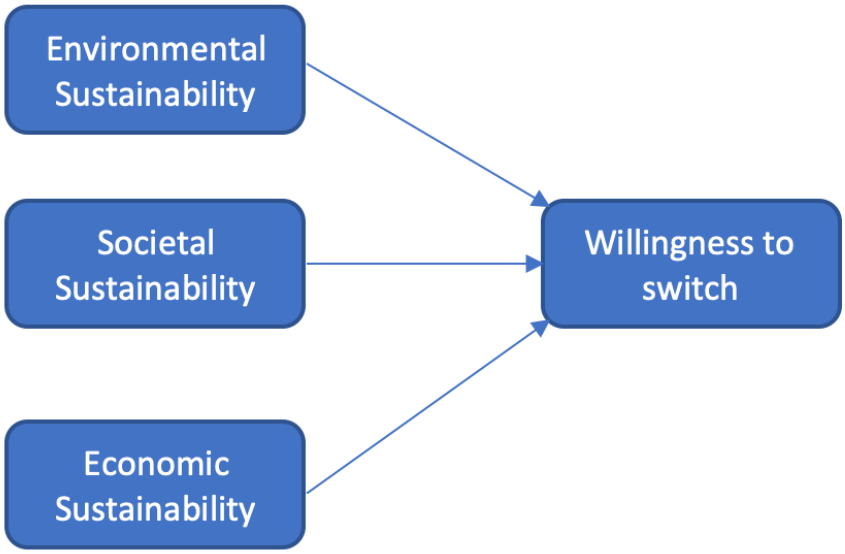
3.2 Data Collection and Analysis

An online survey is the source of data collection for this thesis. It was created via Google Forms on the 6th of May 2022 and distributed mainly with the help of social media as well as word-of-mouth. After 63 responses were recorded the survey was closed on the 11th of May 2022. The majority of participants are the author's friends and family members; however, I have succeeded to achieve a relatively diverse population sample. The questionnaire was split into 4 main sections, each containing 3-5 questions or statements that needed to be answered. In the first part participants were asked to provide their demographic data such as age, gender and education, which were optional, whether they owned any cryptocurrency as well as to rate their knowledge on blockchain based on Likert scale, where 1 meant "Strongly Disagree" and 5 – "Strongly Agree". Each other section was based on the construct indicators that will be discussed in the following section. Finally, the data was analyzed with the help of RStudio with the help of Linear regression testing and Pearson Correlation.

3.3 Theoretical Framework and Hypothesis Development

With the help of the literature review and its findings various construct indicators were formed in order to target the two research questions of the thesis. Their possible relations are expected to help depict the results of the research and represent the public opinion on the topic. The following figure represents the theoretical framework of the study, based on the mentioned construct indicators and their supposed relations.

Figure 5. Factors Affecting Perceived Sustainability of Blockchain.



In order to target every aspect that arises when one talks about the application of blockchain technology in the hospitality industry various hypotheses were formulated. They aim to target two construct indicators, the relationship between which is to be tested based via the survey questions. The hypotheses are designed to test public's perception about the sustainability of blockchain and the factors that may influence it. More specifically, whether any one of the aspects of sustainability has a bigger effect on the opinion about the feasibility of blockchain in the hospitality industry. If such differentiation is detected, this could become a call for further focused research and sustainable development of the technology in that specific area.

Their results can be directly applicable to the hospitality industry as they investigate whether further investment into blockchain is attractive to customers

H1: Perceived environmental sustainability of blockchain has a positive impact on customers' willingness to switch to the blockchain-based systems.

H2: Perceived societal sustainability of blockchain has a positive impact on customers' willingness to switch.

H3: Perceived economic sustainability of blockchain has a positive impact on customers' willingness to switch.

3.4 Survey Development

The survey for the purpose of the research consisted of four parts. Demographic variables were included in order to collect information about the population sample and to verify the validity of the data and to prove that the sample is random and diverse. Three independent variables were also included in the questionnaire, these were perceived environmental, social and economic sustainability, as well as one dependent one – willingness to switch. These construct indicators were tested by 3 to 4 questions. Participants were asked to indicate their opinion based on a 5-point Likert scale, where 1 means "Strongly Disagree" and 5 – "Strongly Agree". Each statement was based on previous research on a similar topic and then modified to fir this thesis. Before each section participants received a short use-case related to the topic. Its purpose was to aid those participants with no previous knowledge on blockchain to answer the questions. The survey was created with the help of Google Forms and distributed through social media via posts and word-of-mouth. The outline of the questionnaire can be found below alongside with the original measuring constructs and their sources as well as the names of the variables that were used for the analysis with RStudio.

Heading:

Perceived Sustainability of Blockchain in the Hospitality Industry and its Impact on Willingness to Switch Applications.

Introduction:

I am a bachelor student at MODUL University of Vienna. This survey is part of an empirical research project for obtaining my Bachelor degree. Thank you for taking your time to answer the questions. All responses will be treated anonymously.

Demographic Variables:

№	Source	Original Question	Updated Question	Variable
1	(Magee et al., 2012)	What is your gender?	Gender	gender
2	(Magee et al., 2012)	What is your age?	Age	age
3	(Magee et al., 2012)	What is the highest level of formal or school education that you have completed?	Highest level of completed formal education	education
4	(Marikyan et al., 2022)	I know quite a lot about blockchain technologies	Do you own any cryptocurrencies?	crypto
5	(Marikyan et al., 2022)	I know quite a lot about blockchain technologies	I know a lot about blockchain technology.	knowledge

Environmental Sustainability:

Blockchain is proposed to significantly reduce food waste, which is currently a very big issue in the hospitality industry. With the help of technology, it is possible to track the hotels' current demand and redistribute unconsumed food, which will significantly improve their ecological performance. Base on this claim and your general opinions, what is your attitude on the environmental sustainability of blockchain in this matter?

№	Source	Original Question	Updated Question	Variable
1	(Kim et al., 2015)	Corporation achieves environmental innovativeness	In my opinion, blockchain in the hospitality industry is an innovative solution for pending environmental issues.	VAR1.1
2	(Kim et al., 2015)	Corporation utilizes green technology	A hotel that uses blockchain technology for food traceability can be called green.	VAR1.2
3	(Kim et al., 2015)	Corporate transparency in business management is good	The transparency of blockchain is beneficial for the hospitality industry in terms of environmental friendliness.	VAR1.3

Social Sustainability:

Winding Tree is a decentralized market place for hotel listings and bookings. Their mission is to give smaller hotels an opportunity to set their own prices and rules when it comes to room reservations (Winding Tree, 2022). Base on this information, please share your opinion about the social sustainability of blockchain:

№	Source	Original Question	Updated Question	Variable
1	(Kim et al., 2015)	Corporation serves social responsibility	Due to cost savings, blockchain makes the travel industry more appealing for small suppliers.	VAR2.1
2	(Kim et al., 2015)	Corporation provides social activities for local communities	Blockchain will allow local hotels to enter the hospitality market.	VAR2.2
3	(Kim et al., 2015)	Corporation cares about human rights	Implementation of blockchain-based online travel agencies will decrease the amount of fraud.	VAR2.3

Economic Sustainability:

Travala.com is a leading online travel agency, which already uses blockchain. Its customers are able to book and pay for their vacation using Bitcoin (Travala.com, 2022). Please answer the following questions based on this information:

№	Source	Original Question	Updated Question	Variable
1	(Choi et al., 2020)	In terms of compatibility, we believe that blockchain platforms are not compatible with our business process.	A blockchain system is compatible with the current business model of the travel industry.	VAR3.1
2	(Liang et al., 2021)	Blockchain technology can satisfy the need of competitive market strategies.	Hotels that use blockchain will remain competitive.	VAR3.2
3	(Liang et al., 2021)	Application of blockchain technology can enhance image of innovation.	Hotels that use blockchain can be called innovative.	VAR3.3

Willingness to switch

This is the last section of the survey. Based on everything you learned in this survey, please answer the following questions:

№	Source	Original Question	Updated Question	Variable
1	(Marikyan et al., 2022)	I like to experiment with new information technologies	Generally, I like to engage with new information technologies.	VAR4.1
2	(Muayad Younus & Raju, 2021)	My interaction with the system would be clear and understandable	My interaction with the blockchain system will be clear and understandable.	VAR4.2
3	(Muayad Younus & Raju, 2021)	I predict I would use the system on the next occasion	I plan to use a blockchain operated tourism company on the next occasion.	VAR4.3
4	(Marikyan et al., 2022)	It would be easy for me to switch to the usage of a blockchain-enabled digital wallet	It would be easy for me to switch to a blockchain-enabled booking platform.	VAR4.4

3.5 Ethical Considerations

Ethical considerations are a crucial part of any research which includes any type of qualitative or a quantitative content analysis. Participants must be protected by the researcher in order to establish further trust and ensure the integrity of the thesis (Creswell, 2014).

For these reasons, in this thesis I do not ask participants to reveal their personal information that can be utilized against their will. First of all, at the beginning of the survey partakers will be notified that their answers will be collected and used to analyze the opinions of the population sample on the particular topic of this thesis. Moreover, every entrant has the opportunity to freely consent for the use of their data. Lastly, the survey is anonymous and does not require any disclosure of personal identifying information as this does not hold any value for this thesis and its findings.

4 Data Results and Analysis

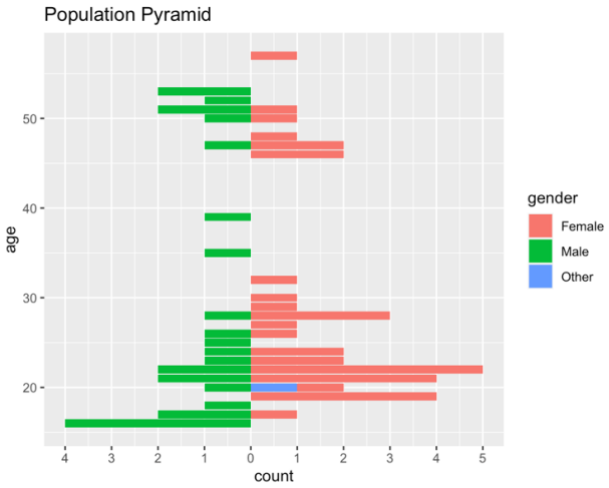
In this section the data collected with the help of the discussed survey will be analyzed and used to either accept or reject the previously defined hypotheses. The hypotheses will then be used to answer the second research question of this thesis, namely *how willing are customers to participate in helping the industry adapt and utilize the technology?* In the following sections each variable will be discussed in detail and then their relationship will be examined. More detailed results that were obtained with the help of RStudio can be found in the Appendix A.

4.1 Demographics

4.1.1 Population

Overall 63 responses were recorded in this study. According to the Google Forms results there are 36 female participants, 26 - male and one person who does not identify as a binary gender. Thus, despite the target group consisting of mostly friends or family members of the author, one can claim that the distribution was relatively even. The graph depicted below represents the population pyramid, more specifically, it shows the age distribution within the sample group. Due to the way responses were collected it is not surprising that the majority of participants are aged from 20 to 30 years old, as this is the approximate age of the author of this thesis.

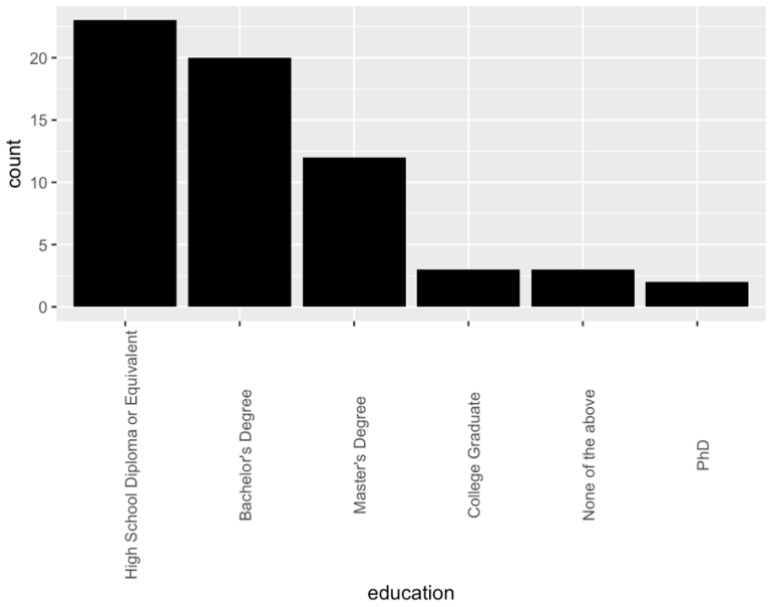
Figure 6. Population Pyramid of the Survey.



4.1.2 Education

Participants were also asked to indicate their highest level of completed education. They were presented with 6 choices, namely High School Diploma or Equivalent, Bachelor, Master or PhD or none of the above. As can be seen on the histogram below, more than two thirds of the participants to this point of time have a high school diploma or a bachelor's degree, which clearly corresponds with the data obtained from the age demographic. On the other hand, only two participants have a completed PhD.

Figure 7. Education of the Respondents.



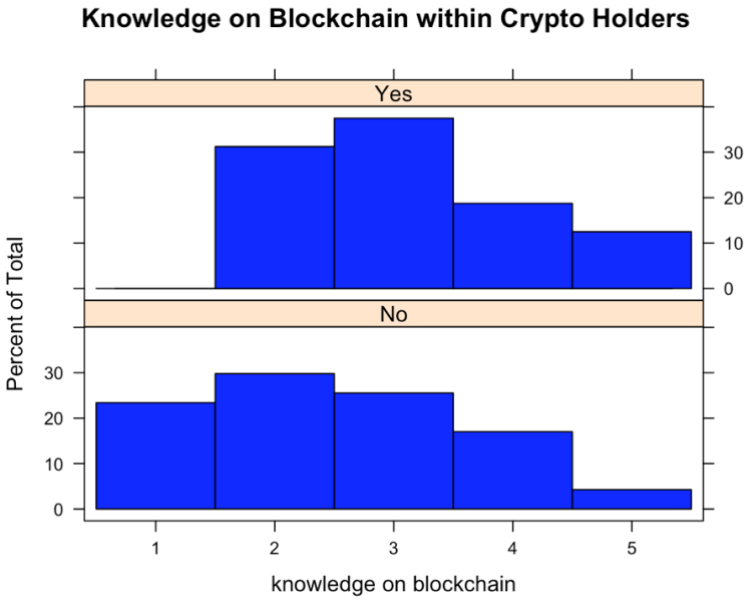
4.1.3 Cryptocurrency and Blockchain Knowledge

Starting from this question participants were asked to rate every statement with a help of a Likert scale with 1 meaning "Strongly Disagree" and 5, consecutively – "Strongly Agree". Such scaling system was used in order to facilitate further handling of the data, which will be further analyzed with the help of the two-sample t-test and Pearson correlation.

In the last section of the demographic variables, participants were asked to indicate whether they have any cryptocurrencies. A bit less than 75% of the respondents

stated they own none. Afterwards, they were asked to rank their understanding of blockchain on a Likert scale. As one would expect holders to have sufficient knowledge about the platform behind cryptocurrencies, it was decided to analyze the responses about familiarity with blockchain within the two previously discussed groups. Interestingly, both distributions appeared to be right-skewed, meaning that very few participants indicated to have a perfect knowledge about blockchain in both categories. However, in comparison to the population with no cryptocurrency assets where approximately half of the answers show no to very little knowledge, none of the holders stated to have absolutely no understanding of the platform. Talking about the whole population sample, 30.2% marked to have little comprehension, followed by 28.6% of participants claiming to have a moderate understanding of the topic.

Figure 8. Knowledge on Blockchain within Cryptocurrency Holders.



4.2 Perceived Environmental Sustainability

In this section respondents were asked to indicate their opinions on how environmentally sustainable blockchain is for the hospitality industry based on their prior knowledge and the information provided with the help of a short use-case.

4.2.1 In my opinion, blockchain in the hospitality industry is an innovative solution for pending environmental issues (VAR 1.1)

The mean for this variable is 3.54 (Appendix A) and a little bit less than two thirds of all the participants have indicated that adopting blockchain to solve various ecological issues can be called innovative. The data for this indicator is left-skewed, what clearly shows that the majority of participants believe the technology to be relatively innovative.

4.2.2 A hotel that uses blockchain technology for food traceability can be called green (VAR1.2)

Interestingly the distribution of the answers for this question is similar to the previous one. However, a bigger number of respondents remained neutral when it came to calling a hotel, that uses blockchain for food traceability, green. This is also supported by the mean value for this variable, which is 3.40 (Appendix A).

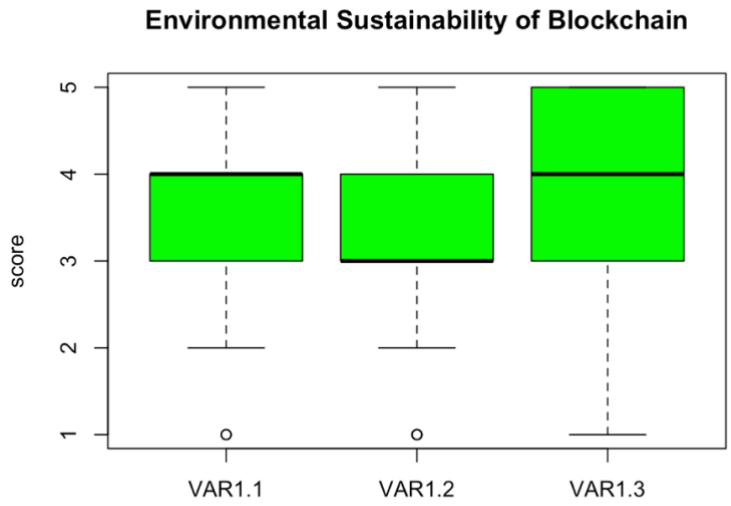
4.2.3 The transparency of blockchain is beneficial for the hospitality industry in terms of environmental friendliness (VAR1.3)

When it comes to the benefits of transparency that blockchain has to offer, the last variable of this construct does not significantly differ from the previous two in terms of data distribution. The only distinction is a higher number of respondents agreeing or strongly agreeing to the perceived benefits of blockchain related to its transparency. The mean value here is 3.73 (Appendix A).

4.2.4 Grouping

On the graph below one can see a bar chart comparison of the three discussed variables. The data looks similarly distributed and thus can be grouped together with the help of a row mean value that will be further used to examine the possible relationship between the construct indicators. It is also interesting whether the variables themselves are in any type of dependency with each other. For that purpose, a two-sample t-test was used on every couple of data sets.

Figure 9. Comparison of VAR1.1, VAR1.2 and VAR1.3.



Starting with the first two (VAR1.1 and VAR1.2), the Welch Two Sample t-test produced a p-value of 0.45 (Appendix A). This value shows no statistical significance and thus there is a strong presence of null hypothesis, that states that there is no relationship between the two variables. Similarly, there was no dependency detected between the variables VAR1.1 and VAR1.3, where the significance index was 0.32 < 0.05 (p-value from Appendix A). The p-value for VAR1.2 and VAR1.3 was close to 5% (0.07), however, it is still not small enough to reject the null hypothesis. Consequently, the two-sample t-test detected no relationship between the variables that were used to test the perceived environmental sustainability of blockchain.

To conclude this section, another Welch two-sample t-test was used to determine whether this construct in dependent on the prior knowledge about blockchain of the population sample. The p-value of 3.32e-06 (Appendix A) shows a great significance level, which means that the two variables are related to each other. To conclude, respondents' knowledge about DLT impacts the perceived environmental sustainability of blockchain.

4.3 Perceived Societal Sustainability

For this section respondents where briefly introduced to the Winding Tree organization. Afterwards, participants had to indicate their opinions on the societal sustainability of blockchain in hospitality by answering the three following questions.

4.3.1 Due to cost savings, blockchain makes the travel industry more appealing for small suppliers (VAR 2.1)

The first variable for the social sustainability construct aims to test whether participants agree that the cost savings caused by adoption of blockchain in hospitality will make it easier and more appealing for the smaller hotels and related businesses to operate in the market. A mean of 3.70 shows the majority of the respondents have a positive attitude towards this statement. Actually, nearly two thirds (39 of 63 participants) answered “agree” or “strongly agree” to this question.

4.3.2 Blockchain will allow local hotels to enter the hospitality market (VAR2.2)

Interestingly, VAR2.1 and VAR2.2 have identical means of 3.70 (Appendix A), however they slightly differ from one another. To compare the two, one may look at the two histograms (Appendix B) depicting this distinction. It is obvious that the data differs in the number of answers for such categories as neutral and agree, the overall trend however, is alike. This can be caused by the similarity of the two questions that target respondents’ perception of how blockchain would impact small and local hotels.

4.3.3 Implementation of blockchain-based online travel agencies will decrease the amount of fraud (VAR2.3)

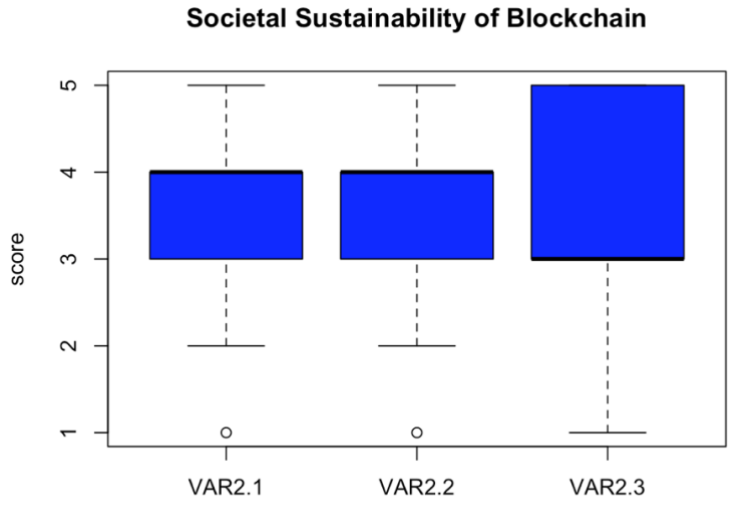
The last variable of this construct indicator does not depict a bell-shaped distribution as the majority of respondent were either neutral or strongly agreed with the statement (Appendix B). The overall attitude is, however, relatively positive as the data is left-skewed and the mean lies at 3.51 (Appendix A).

4.3.4 Grouping

Figure 10 (below) uses bar charts to compare the discussed variables. As mentioned before, the first two are presented in the same way due to their identical mean values. The overall distribution trend is also similar for this construct indicator.

Before determining the row mean value of the three variables, it is interesting to once again look at the possible relations within the three data sets. For further information one can address a corresponding t-test summary in Appendix A. Surprisingly, when it comes to the Welch two-sample t-test between the seemingly different data sets VAR2.1 and VAR2.2, the result showed a rare p-value that equals to 1, which is usually found when the variables are identical. Such result means that the two questions tested the same information. It is also interesting that when these two variables were compared with the last one (VAR2.3) the results were different, which proves that the previous results were not caused by any external issue. For instance, the t-test of VAR2.1 and VAR2.3 resulted in a p-value of 0.31, which depicts no relationship between the two variables. Lastly, VAR2.2 and VAR2.3 also proved to have no correlation between them, as the p-value (0.30) was higher than 0.05.

Figure 10. Comparison of VAR2.1, VAR2.2 and VAR2.3.



Similar to the previous section it was decided to inspect whether the knowledge about blockchain and the row mean for the societal sustainability of the technology are related. For this purpose, the Welch two-sample t-test was conducted. It can be inferred that there is a link between the two variables based on the computed p-value of 2.11e-07 (Appendix A). The implications of this finding will be reviewed in the upcoming section of the thesis, more specifically, in the "Discussion" part.

4.4 Perceived Economic Sustainability

In order to test economic sustainability of blockchain in the hospitality industry the three following variables were created based on the survey answers. Travala.com was used in this section for the purpose of making sure that every participant provides their educated opinion on the topic.

4.4.1 A blockchain system is compatible with the current business model of the travel industry (VAR3.1)

This variable aims to address participants' opinion on whether blockchain is compatible with hotels' business model. The mean for VAR3.1 is 3.762 (Appendix A) and the data is left-skewed (Appendix B). The majority of answers are relatively evenly spread between "neutral", "agree" and "strongly agree". This represents strong positive opinions of the respondents regarding these questions.

4.4.2 Hotels that use blockchain will remain competitive (VAR3.2)

Competitiveness is an important topic when talking about the economic sustainability of blockchain. Thus, for this thesis it is crucial to analyze whether respondents think that hotels that utilize DLT are competitive when compared to the ones with the centralized technology. VAR3.2 is also left-skewed where more than one third (25 responses) showed a strong positive attitude towards the issue (Appendix B). The mean value for this variable is 4.01 (Appendix A), which supports the previous statement.

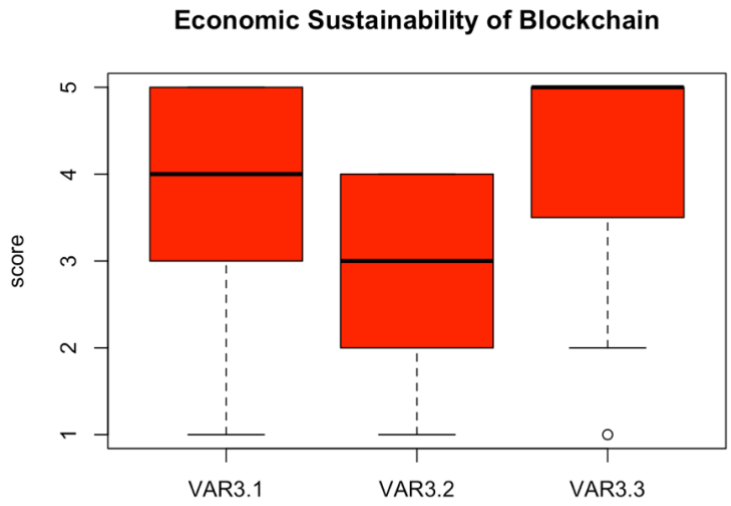
4.4.3 Hotels that use blockchain can be called innovative (VAR3.3)

Another variable that is relevant for economic sustainability is innovativeness. Inventive hotels are expected to be more profitable and competitive in comparison to others. That is why with this question I wanted to obtain respondents' opinion on the issue. VAR3.3 has a mean value of 4.21 (Appendix A) and the data set is left-skewed (Appendix B). Interestingly, more than half of the participants indicated that they strongly agree that hotels that use blockchain can be called innovative.

4.4.4 Grouping

Below, figure 11 represents the comparison of the three variables that were used to test the perceived economic sustainability of blockchain in the hospitality industry. It is obvious that VAR3.2 differs from the other two data sets, hence it is interesting to look at the Welch two-sample t-test in order to determine their possible relationship. To begin with, the p-value for the variables VAR3.1 and VAR3.2 is 0.05 (Appendix A), which is close to the significance level of 0.05, however, one cannot reject the null hypothesis and can claim that there is no significant relation between the two. When it comes to the second and the third data sets, test result showed a p-value of 0.51 (Appendix A), which clearly indicates that there is no correlation between the perceived competitiveness and innovativeness of a hotel that utilizes the blockchain technology. Surprisingly, there was a relation detected between VAR3.1 and VAR3.3. The Welch test resulted in a p-value of 0.02 (Appendix A), which leads to rejecting the null hypothesis. This means that according to the population sample there is a relationship between blockchain's perceived compatibility with the current business model of the travel industry and the fact that hotels that use the technology can be called innovative.

Figure 11. Comparison of VAR3.1, VAR3.2 and VAR3.3.



Lastly, it was interesting to find out whether the derived mean variable, which represents this construct indicator is influenced by the participants' prior knowledge about blockchain. For this assessment a Welch two-sample t-test was once more performed on the two data sets, namely knowledge on blockchain and row mean for the perceived economic sustainability of the technology. According to the obtained p-value of 2.68e-12 (Appendix A), it can be concluded that there is indeed a relationship between these two variables.

4.5 Willingness to Switch

Lastly, this section analyzes how willing are potential customers to switch to a blockchain-operated platform. The section consists of four variables and each of them was designed to test how likely potential customers are to choose a hotel that adopted blockchain when compared to one operating on a fully centralized system. Willingness to switch is in this thesis the dependent variable and will be tested as such in the following sections in order to prove or disprove the hypotheses.

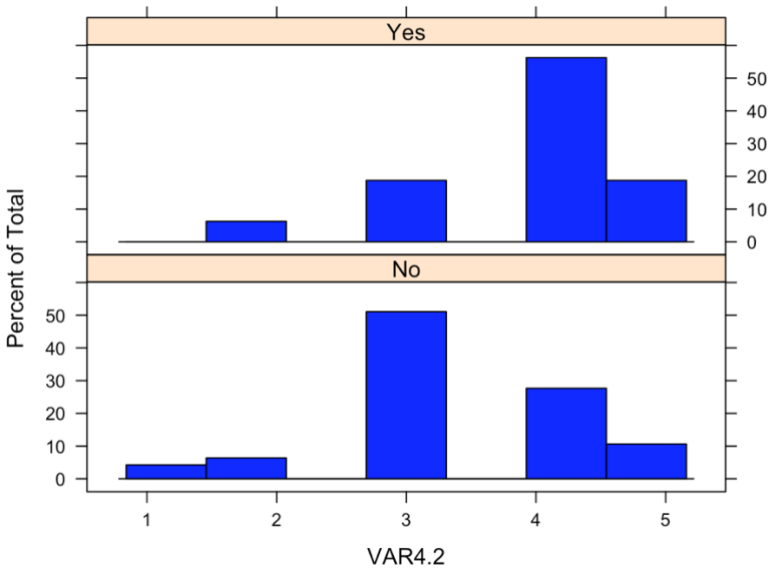
4.5.1 Generally, I like to engage with new information technologies (VAR4.1)

The first question in this section is asking whether the respondents are generally open to experimenting with the new technologies. It is expected that this variable will also have a positive relationship with the following questions in this section. VAR 4.1 has a mean value of 4.22 (Appendix A), which clearly indicates that the majority of survey participants are likely to engage with new technologies, thus it can be expected that they will be willing to also try blockchain-operated businesses and platforms. 50.8% of respondents stated that they strongly agree with the statement, with only one person answering “Strongly Disagree” on this topic (Appendix B).

4.5.2 My interaction with the blockchain system will be clear and understandable (VAR4.2)

For VAR4.2 the mean lies at 3.48 and the distribution is rather bell-shaped. Overall, only 6 respondents indicated that their interaction with blockchain will not be easy, while the majority (42.9%) remained neutral on the topic (Appendix B). Clarity of contact with technology is an important aspect of willingness to switch. Thus, it was interesting to analyze whether the data distribution is different within cryptocurrency holders. As one can see from figure 12 below, the answers for both cases are not evenly distributed. It is not surprising that the majority of the cryptocurrency holders indicated that their interaction with the blockchain system will be clear and understandable as to one extent they are already familiar with the technology. Hence, the data in the crypto-owners section is left-skewed, while the distribution of answers within participants with no such asset is centered and bell-shaped.

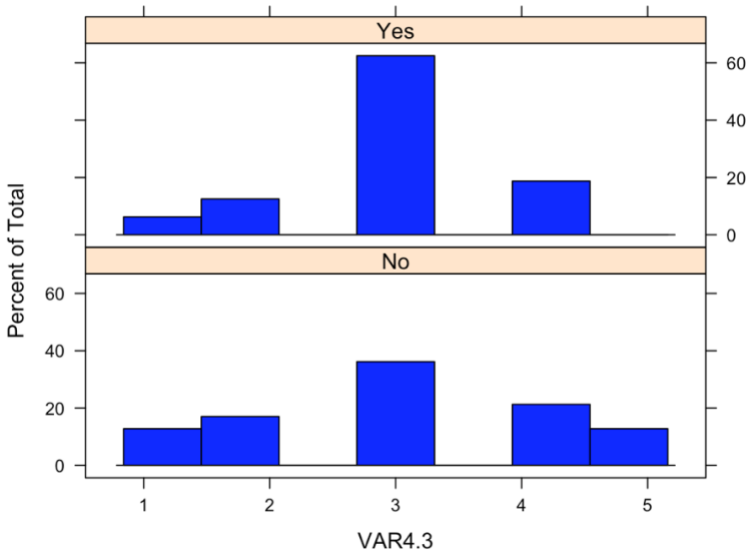
Figure 12. Comparison of VAR4.2 Within Holders and Respondents with no Crypto Assets.



4.5.3 I plan to use a blockchain operated tourism company on the next occasion (VAR4.3)

The mean for this variable is 3.02 (Appendix A) which corresponds with the fact that 42.9% of participants remained neutral on the issue (Appendix B). This indicates that to this point of time majority of the potential customers who participated in this survey remain unsure whether they will be willing to use a blockchain operated company on the next occasion. Interestingly, when it comes to the data distribution within cryptocurrency owners and those without such assets, both sets are centered and bell-shaped, which signifies that the overall trend is similar for the two categories.

Figure 13. Comparison of VAR4.3 Within Holders and Respondents with no Crypto Assets.



4.5.4 It would be easy for me to switch to a blockchain-enabled booking platform (VAR4.4)

This variable is designed to test how easy would it be for potential customers to switch to a blockchain operated platform. The mean value for this data set is 3.32 (Appendix A) and the answers are almost evenly distributed between the five responses (Appendix B). Since there is no particular pattern in the distribution, it was decided to analyze which of the demographic variables may have an effect on the perceived effortlessness in switching to a blockchain-based system. When it comes to availability of cryptocurrency assets, however, this factor did not display a significant impact on the variable (Appendix B). What was interesting, however, is that the two-sample Welch t-test showed a significant relationship between age of respondents and their perceived facility to switch to a blockchain-operated booking platform (Appendix A).

4.5.5 Grouping

The graph below, which depicts the comparison of the four discussed variables, confirms the previously formed presumptions. Moreover, the three last data sets have a clearly similar distribution.

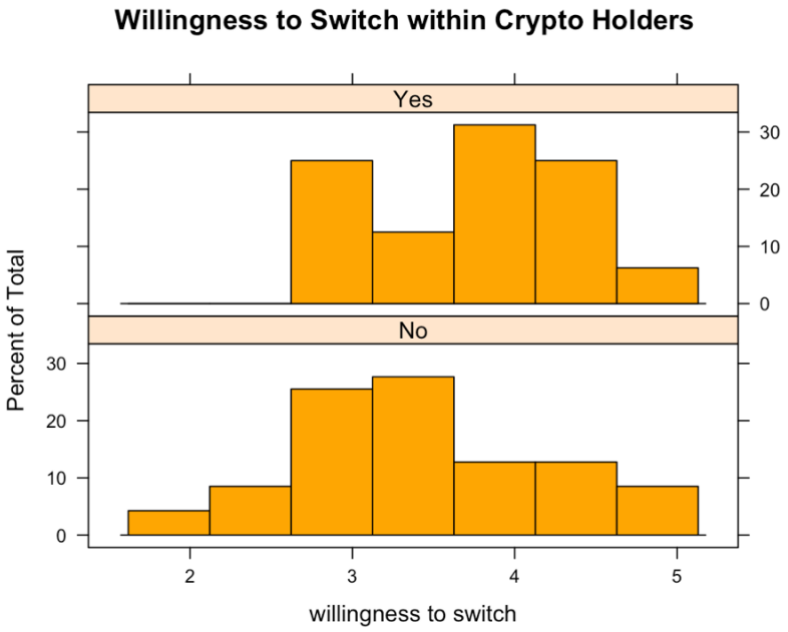
Surprisingly, the Welch two-sample t-test concluded that there is a strong relationship between VAR4.1 and VAR4.2. This means that a correlation exists between population's excitement to engage with new information technologies and their perceived difficulty of interaction with a blockchain-based platform. The p-value in this case was significantly below 0.05 (1.72e-05) (Appendix A), which is the ground for the driven conclusion. Similarly, both VAR4.3 and VAR4.4 stay in relation to VAR4.1 as the p-values are 1.34e-09 and 1.34e-05 accordingly (Appendix A). These results prove that a person's general attitude towards new technologies has a direct impact on the other three variables that were used to test customers' willingness to switch. The other two pairs of variables, namely VAR4.2 and VAR4.4 as well as VAR4.3 and VAR4.4, marked no detectable correlation. The p-values are accordingly 0.42 and 0.15 (Appendix A), which is clearly above the significance level of 5%.

Lastly, it is interesting, that this construct has another two data sets that are in relationship with each other. These are VAR4.2 and VAR4.3. After conducting a Welch two-sample t-test and obtaining a p-value of 0.01, it is clear that there is a correlation between perceived difficulty of utilizing a blockchain-operated platform and the desire to use a DLT-based tourism company on the next occasion.

Figure 14. Comparison of VAR4.1, VAR4.2, VAR4.3 and VAR4.4.

It is also predictable that the overall willingness to switch is not equally distributed when the data is differentiated between participants with cryptocurrency assets and those without. As one can see on the figure below, the majority of respondents with this type of eCash have a positive attitude towards adapting blockchain. Meanwhile, the data distribution within participants with no cryptocurrency is relatively right-skewed and around two thirds have a rather negative attitude towards switching from the centralized analogy. This assumption is clearly supported by the data analysis as the Welch two-sample t-test produced a p-value of 3.22e-06 (Appendix A), which signifies that whether a person has prior knowledge about blockchain has an impact on their willingness to utilize DLT.

Figure 15. Comparison of Willingness to Switch based on Availability of Cryptocurrency Assets.



In the following section I will test the previously formed hypotheses by performing Pearson Correlation analysis on each of the independent variables together with the dependent one. For this purpose, each set of questions was grouped with a help of row mean value, that is further used to analyze the dependencies between the construct indicators. Afterwards, in order to either reject or accept the derived

hypotheses, a p-value for each pair of construct indicators will be found with the help of Welch two-sample t-test correlation.

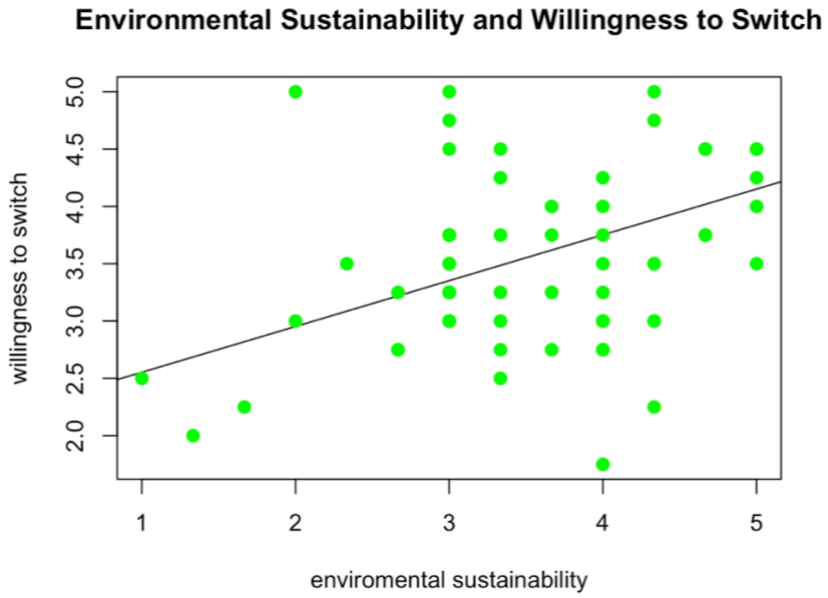
4.6 Hypothesis 1

The first set of hypotheses was designed to examine the impact that the independent variable "perceived environmental sustainability" has on the dependent "willingness to switch". They are presented below:

H1: *Perceived environmental sustainability of blockchain has a positive impact on customers' willingness to switch to the blockchain-based systems.*

As one can see at the Figure 15 (below), there is a relatively clear trend between willingness to switch to a DLT-operated platform and perceived sustainability of blockchain. Majority of the points on the graph are located around the regression line that can be also found on the graph, which indicates that there is some type of a relation between these two construct indicators. The bigger amount of answers are are in the central to right upper corner. This represents the results that have been discussed previously indicating that the overall opinion of the respondents on the topic is positive. This assumption needs to be tested with the help of Pearson correlation. The result of the corresponding analysis for these two construct indicators is approximately 0.34 (Appendix A). Such coefficient signifies a positive correlation of a moderate degree. This supports the previously discussed assumption based on the graph below. Hence, the collected data does provides enough information to accept the first hypothesis. It can be concluded that the perceived environmental sustainability of blockchain has an impact on customers willingness to switch to the blockchain-based systems. Overall, guests are concerned how green the hotel of their choice is, thus they are more willing to choose a company that uses a blockchain-operated platform if they perceive it as a green solution for the pending environmental problems. Thus, perceived environmental friendliness plays an important role in customers' willingness to choose a hotel that utilizes DLT.

Figure 16. Linear Regression Analysis Between Perceived Environmental Sustainability and Willingness to Switch.



4.7 Hypothesis 2

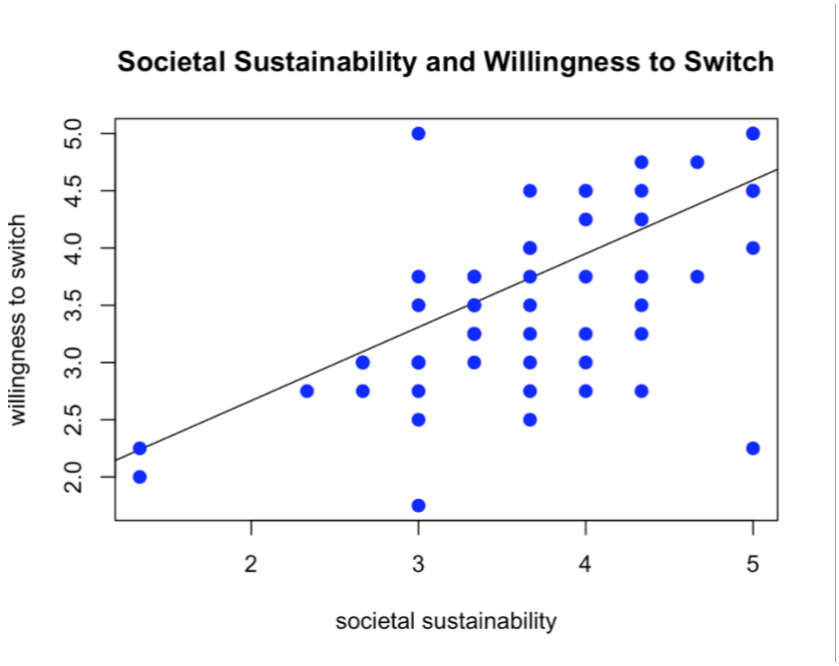
The second set of hypotheses tests whether there is a relationship between perceived societal sustainability of DLT and customers' willingness to switch to a blockchain-operated platform. For the purpose of this analysis a row mean value was derived from the three and consequently four variables that were used to test the construct indicators.

H2: *Perceived societal sustainability of blockchain has a positive impact on customers' willingness to switch.*

To begin with, a linear regression was plotted with the help of RStudio. The data seems to have a relatively strong linear relationship as it is allocated around a straight regression line. In comparison to the previous graph the data for the second hypothesis is more concentrated, hence depicting a stronger correlation. There are also less outliers with only 3 responses that do not follow the overall trend. To prove this assumption based on the visual representation, one should determine a relation coefficient. For this purpose, Pearson correlation was used. The resulting value is

around 0.61, which signifies that there is a correlation of a moderate to high degree between the two construct indicators. This result indicates that the second hypothesis can be accepted and the derived conclusion is that based on the collected population sample, perceived societal sustainability of blockchain has an impact on customers' willingness to switch. Not only the decreased amount of fraud is important to customers, but also according to the test results, their concern about societal sustainability of blockchain influences the inclination to use the system.

Figure 17. Linear Regression Analysis Between Perceived Societal Sustainability and Willingness to Switch.



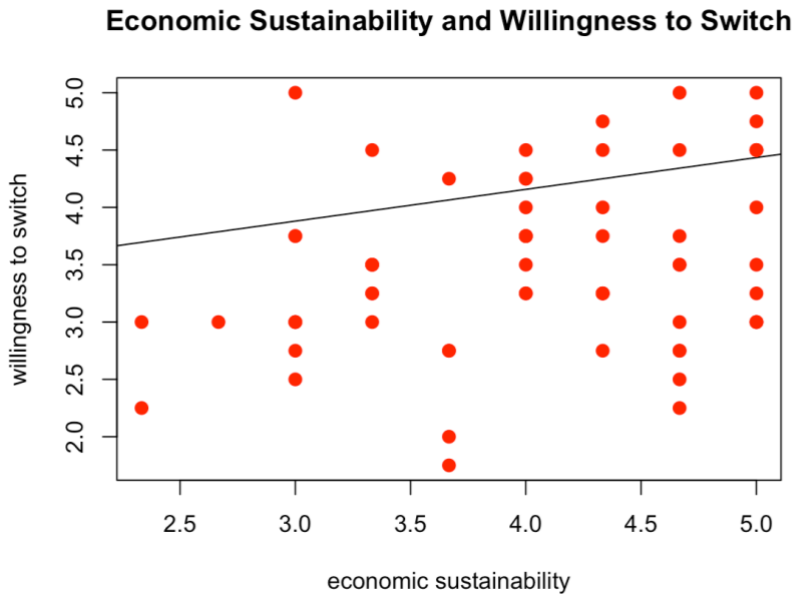
4.8 Hypothesis 3

The last set of hypotheses targets the third nest of sustainability, namely economic sustainability. More specifically, this section aims to examine whether this factor has an impact on customers' openness to turn to a blockchain-based system instead of using a centralized software when interacting with the hospitality industry.

H3: *Perceived economic sustainability of blockchain has a positive impact on customers' willingness to switch.*

On the figure 17 a linear regression analysis between perceived economic sustainability and willingness to switch are depicted. In comparison to the previous results the degree of correlation between the two constructs is low. The data is spread across the graph and represents a variety of different responses. The answers also do not follow the marked regression line, which has a noticeably low incline, that represents a low rate of change between the responses. This claim is also supported by the Pearson correlation result of approximately 0.28 (Appendix A), which clearly indicates a small association. In this case the previously formed hypothesis is not accepted and one can conclude that the perceived economic sustainability of blockchain has almost no impact on customers willingness to switch to the blockchain-based systems.

Figure 18. Linear Regression Analysis Between Perceived Economic Sustainability and Willingness to Switch.



5 Discussion

This section is used to discuss the findings of both the literature review and the survey as well as the data analysis. The thesis aims to answer two of the research questions, namely *what are the main areas of concern and opportunities of adapting blockchain in the hospitality industry* and *how willing are customers to participate in helping the industry adapt and utilize the technology.* The first question refers to the literature review findings. In order to visually summarize and represent the results, tables below were created. Main environmental concerns caused by the technology are due to its upgrowing power consumptions. Mining consumes plenty of electricity, production of which is related to high rates of carbon emissions. However, according to the previous research DLT requires much less resources when compared to its alternatives. It is believed that with the help of further development of this technology it will become less ecologically disruptive. Future advancement of blockchain is also expected to resolve the problem of scalability. Nowadays, DLT is not able to support the amount of transactions needed for its use by the mass public.

Table 2. Environmental Disadvantages of Implementing Blockchain in the Tourism and Hospitality Industry.

№	Name	Description
1	High electricity consumption	Bitcoin's power usage is claimed to be above that of numerous countries and major IT businesses.
2	Carbon emissions	Blockchains are designed to need a lot of energy, and the amount of produced carbon dioxide emissions increases rapidly with each year.

Table 3. Environmental Advantages of Implementing Blockchain in the Tourism and Hospitality Industry.

№	Name	Description
1	Reduced business waste	Blockchain's traceability minimizes the need for mediators in the supply network, as well as the amount of necessary quality controls, resulting in a considerable reduction in corporate waste.
2	Traceability – easier taxation	Product tracing can be utilized by the responsible parties to compute the tax amount owed by a company.
3	Tokens - motivation to recycle	In Northern Europe customers are digitally compensated for properly disposing of their trash and the financial awards in the form of cryptocurrency have already shown their usefulness.

Human rights is an important topic of social sustainability movements. That is why concerns about privacy and illegal activities are an important discussion when it comes to blockchain. Cryptocurrencies are indeed linked to various cases of unlawful acts. However, with clear supportive and regulative policies these issues can be easily addressed. As any financial or related system, blockchain requires effective governmental laws to be implemented. They are expected not only to help with the pending disadvantages of the system, but also to introduce more possible use-cases of the technology, such as, for example, identity management.

Table 4. Societal Disadvantages of Implementing Blockchain in the Hospitality Industry.

№	Name	Description
1	Scalability	When it comes to transaction volume and speed, distributed networks are currently unable to compete with their centralized counterparts.
2	Privacy concerns	There still are concerns associated with blockchain's transparency and immutability. Data that cannot be erased might be regarded as a violation of privacy.
3	Criminal activities and Illegal transactions	The anonymity of blockchain has resulted in several illegal acts linked to Bitcoin.
4	Loss of working places	Decentralization offers cheaper processes by eliminating the intermediary, but it also results in a significant loss of jobs as a result of the new technology.
5	Complexity of the technology	Because even the fundamentals of blockchain might be difficult to grasp, educational initiatives should be prioritized in order to assure users of the network's reliability.

Table 5. Societal Advantages of Implementing Blockchain in the Hospitality Industry.

№	Name	Description
1	Identity Management	Immutability and verifiability are the two features of technology that provide the system in which particular data is tied to a particular identity and thus can be verified without the risk of it being tampered with by an unauthorized authority.
2	Credibility of online reviews	In order to authenticate and increase the reliability of online consumer evaluations, a blockchain network can be used.
3	Transparent goods for buyers	A clear record of a product lifecycle aids customers in making purchasing decisions and avoiding dishonest vendors.
4	Less corruption	Blockchains are resilient to dishonest agents that try to behave unfairly at the cost of others since only the majority of network users may authorize and implement changes.

In the hospitality industry blockchain introduces a variety of possible applications that are expected to bring new and attractive features to its businesses. One example of such implementations is baggage tracking. Furthermore, DLT has potential benefit to already existing processes. With blockchain it is possible to automatize different operations that are currently performed manually. This leads to the most attractive advantage of implementing blockchain in the hospitality from the perspective of the hotels, namely cost savings. It ranges from cheaper transactions to removal of

intermediaries and will allow hotels focus on other important aspects of the business, rather than paying the mediator fees.

Table 6. Economic Disadvantages of Implementing Blockchain in the Tourism and Hospitality Industry.

№	Name	Description
1	Funding requirements	Transitioning to the blockchain network will demand a significant investment.
2	Need for supportive policies	To guarantee that the network is a safe and provides a lawful environment for enterprises, effective government rules are required.

Table 7. Economic Advantages of Implementing Blockchain in the Tourism and Hospitality Industry.

№	Name	Description
1	Cryptocurrency payments	Many businesses are beginning to accept cryptocurrency payments, which not only offers lower transaction costs but also provides a cheaper currency conversion option.
2	Smart contracts for SCM	The transparency of blockchain enables the elimination of intermediaries when it comes to contracts, thus lowering associated expenses.

3	Cheaper transactions	The current status of the tourist sector has an inefficiently high cost structure, since data frequently travels through several instances and verifications. Blockchain enables an automatic verification, which lowers transaction costs dramatically.
4	Solves double marinization problem	The lower expenses of a decentralized network will provide local hotels access to the market and allow them to compete fairly with larger businesses.
5	Baggage tracking	Baggage tracking is one example of blockchain applications in hospitality. The system's traceability aids inventory control as well as the tracking of guests' personal items.
6	Booking	The usage of smart contracts paired with identity management innovations is expected to change the current booking process.
7	Loyalty programs	With blockchain, it is possible to link numerous applications that will enable the trade of loyalty tokens among users.
8	Employee benefits	Employees can be given tokens instead of or in addition to their bonuses.
9	Positive impact on innovation	Smaller businesses will be able to focus on their own development if they can become financially independent of OTAs.

The second part of the thesis focused on whether the previously discussed advantages and disadvantages of blockchain have an impact on participants' willingness to switch from a centralized system to DLT. Customer satisfaction is a crucial part of any business and for a hotel to remain competitive it is important to understand how their actions will be perceived by their guests. In the tables below, I summarized the findings of the analysis of the prior determined hypotheses.

Table 8. Economic Advantages of Implementing Blockchain in the Tourism and Hospitality Industry.

№	Hypothesis	Status
1	Perceived environmental sustainability of blockchain has a positive impact on customers' willingness to switch.	accepted
2	Perceived societal sustainability of blockchain has a positive impact on customers' willingness to switch.	accepted
3	Perceived economic sustainability of blockchain has a positive impact on customers' willingness to switch.	rejected

It is clear from the table that the survey did not detect any significant relation between perceived economic sustainability of the technology and customers' willingness to switch. It is interesting, however, that the first and second hypotheses were accepted as a result of the analysis. These construct indicators focused on such variables as environmental friendliness and social responsibility of a hotel that utilizes blockchain. Thus, according to the data, guests' preference lies with hotels that follow sustainability trends. Such findings signify that nowadays customers are becoming more conscious about the feasibility of the companies of their choice. Thus, further development of blockchain to make it more environmentally sustainable is expected to positively impact guests' perceptions about hotels that utilize the technology and, thus, increase the competitiveness of the hospitality companies that operate on DLT.

Lastly, the fact that all the construct indicators were found to be dependent on participants' prior knowledge on the topic of DLT can be seen as a call for further scientific and media coverage of blockchain technology. It is obvious that respondents displayed a more positive attitude towards not only the utilization of the technology, but also the familiarity with the topic positively altered their opinions on current sustainable benefits that blockchain is able to introduce to the hospitality industry. This displays the importance of further education of the mass population on the topic as it is believed to establish a certain level of trust to this innovation. Consequently, customers would be more willing to switch to a blockchain-operated hotel or a related business, which will incentivize further adaption of this technology.

6 Conclusion

The main purpose of this thesis was to investigate the consequences of implementing blockchain in the hospitality industry and the degree to which customers are willing to support this innovation. The findings indicated that the technology has countless possible applications and with the help of the right tools it can be highly beneficial for the hotel industry. The "tools" range from supportive policies to media coverage. In this study it was determined that prior knowledge about DLT has a significantly positive impact on customers attitude towards blockchain. To this point of time the technology is not mature enough to be widely implemented in every sphere discussed previously, however there are already various examples and use-cases of blockchain. The features that the technology presents are expected to make hospitality companies operate in a more efficient way; and such innovativeness and adaptability of the industry alongside with its sustainabile practices is what is desired by many guests.

6.1 Future Research

As blockchain becomes increasingly popular, new applications for the technology in numerous areas of life emerge on a regular basis. With the advancement of blockchain, it is expected that many unique options for its implementation, particularly in hospitality, will emerge. Before taking any harmful action, it is critical to thoroughly research these methods. Due to the lack of real-life instances, the collected data on the blockchain technology is primarily based on experimental results, and several scientists have already published a call to action to prompt a more thorough assessment. Without a deep research on the subject, it may take a while for organizations to agree on new ways of implementation. As a result, additional investigation should more closely examine the economic consequences of incorporating blockchain technology into the hospitality industry. More specifically, I propose to investigate the amount of capital investments needed for a hotel to adapt to a different, more sustainable model. This is a particularly important topic because of the heterogenous nature of the hospitality industry. Not every small hotel or supplier will be willing to make big investments, and hence a system should be

developed, which will ensure that the implementation will remain affordable and that it would not require many additional expenditures, on, for example, employee reeducation. Lastly, as discussed before, it is important not only to inform businesses about the technology, but also to involve more media attention towards DLT, more specifically, to educate potential customers about benefits and properties of blockchain, as it was proved to have a significant effect on clients' attitude towards this invention.

6.2 Limitations

This thesis has several limitations. First of all, when it comes to the population sample, since the participants where gathered within friends, family members and network of the creator of this study, the findings of the thesis might be biased as majority of the respondents share a similar background and/or interests as the author. More specifically, more than half of all the participants are aged from 20 to 30 years old and more than 68% percent of the whole sample has either a high school diploma or a finished bachelor's degree. Moreover, due to the similarity of interests in the author's circle, around one fourth of the participants are cryptocurrency holders, meanwhile according to TripleA (2021) in Austria only 1.91% percent of the whole population owns cryptocurrency assets. Moreover, 63 responses that were recorded in this study is a relatively small sample and it is believed to have not been enough to prove the significance of some of the expected relationships. Hence, the obtained results and conclusions are potentially not to be generalized to the whole population.

Finally, it is important to note that the survey was created after the Covid-19 pandemic, when the travel industry just started to regain popularity within its customers. It is not surprising that this situation had a significant effect on guests' perception of both new technologies and hospitality, and the obtained figures can be expected to alter in the nearest future.

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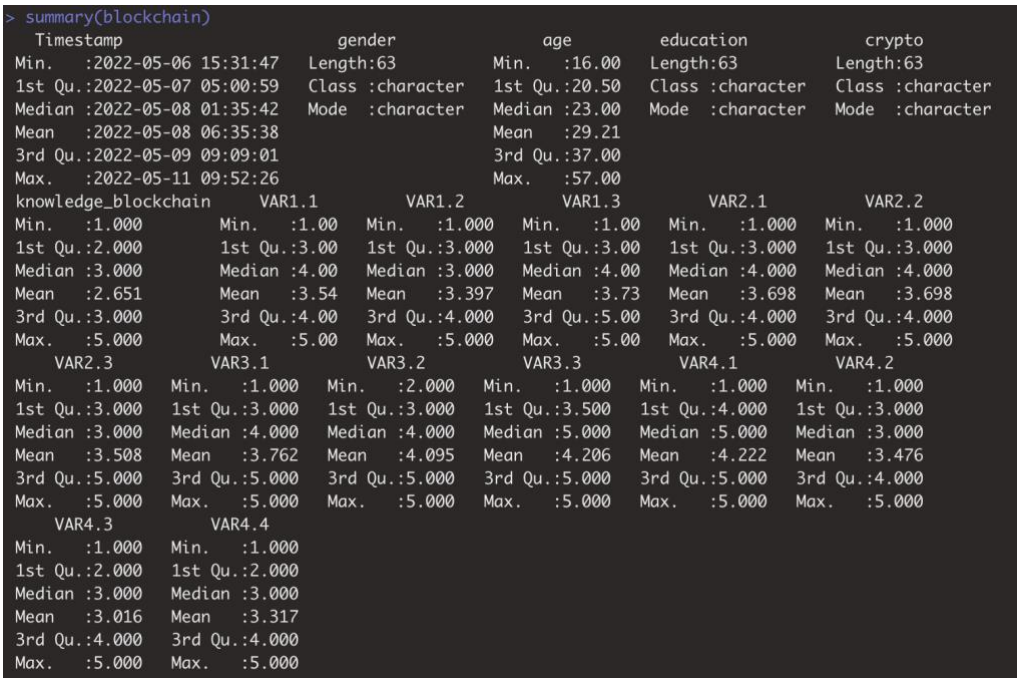
Appendices

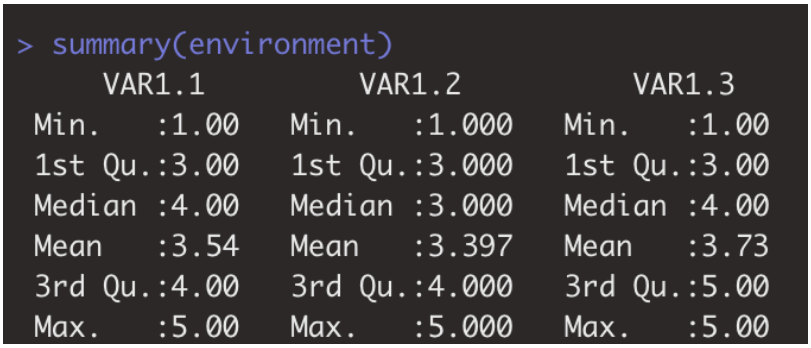
Appendix A

Figure 19. Summary of the Survey Results.



```
> summary(blockchain)
   Timestamp                      gender              age         education           crypto
 Min.   :2022-05-06 15:31:47   Length:63          Min.   :16.00   Length:63          Length:63
 1st Qu.:2022-05-07 05:00:59   Class :character   1st Qu.:20.50   Class :character   Class :character
 Median :2022-05-08 01:35:42   Mode  :character   Median :23.00   Mode  :character   Mode  :character
 Mean   :2022-05-08 06:35:38                      Mean   :29.21
 3rd Qu.:2022-05-09 09:09:01                      3rd Qu.:37.00
 Max.   :2022-05-11 09:52:26                      Max.   :57.00
 knowledge_blockchain     VAR1.1          VAR1.2          VAR1.3          VAR2.1          VAR2.2
 Min.   :1.000        Min.   :1.00   Min.   :1.000   Min.   :1.00   Min.   :1.000   Min.   :1.000
 1st Qu.:2.000        1st Qu.:3.00   1st Qu.:3.000   1st Qu.:3.00   1st Qu.:3.000   1st Qu.:3.000
 Median :3.000        Median :4.00   Median :3.000   Median :4.00   Median :4.000   Median :4.000
 Mean   :2.651        Mean   :3.54   Mean   :3.397   Mean   :3.73   Mean   :3.698   Mean   :3.698
 3rd Qu.:3.000        3rd Qu.:4.00   3rd Qu.:4.000   3rd Qu.:5.00   3rd Qu.:4.000   3rd Qu.:4.000
 Max.   :5.000        Max.   :5.00   Max.   :5.000   Max.   :5.00   Max.   :5.000   Max.   :5.000
     VAR2.3          VAR3.1          VAR3.2          VAR3.3          VAR4.1          VAR4.2
 Min.   :1.000   Min.   :1.000   Min.   :2.000   Min.   :1.000   Min.   :1.000   Min.   :1.000
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.500   1st Qu.:4.000   1st Qu.:3.000
 Median :3.000   Median :4.000   Median :4.000   Median :5.000   Median :5.000   Median :3.000
 Mean   :3.508   Mean   :3.762   Mean   :4.095   Mean   :4.206   Mean   :4.222   Mean   :3.476
 3rd Qu.:5.000   3rd Qu.:5.000   3rd Qu.:5.000   3rd Qu.:5.000   3rd Qu.:5.000   3rd Qu.:4.000
 Max.   :5.000   Max.   :5.000   Max.   :5.000   Max.   :5.000   Max.   :5.000   Max.   :5.000
     VAR4.3          VAR4.4
 Min.   :1.000   Min.   :1.000
 1st Qu.:2.000   1st Qu.:2.000
 Median :3.000   Median :3.000
 Mean   :3.016   Mean   :3.317
 3rd Qu.:4.000   3rd Qu.:4.000
 Max.   :5.000   Max.   :5.000
```

Figure 20. Summary of the Environmental Sustainability Construct Variables.



```
> summary(environment)
     VAR1.1          VAR1.2          VAR1.3
 Min.   :1.00   Min.   :1.000   Min.   :1.00
 1st Qu.:3.00   1st Qu.:3.000   1st Qu.:3.00
 Median :4.00   Median :3.000   Median :4.00
 Mean   :3.54   Mean   :3.397   Mean   :3.73
 3rd Qu.:4.00   3rd Qu.:4.000   3rd Qu.:5.00
 Max.   :5.00   Max.   :5.000   Max.   :5.00
```

Figure 21. t-test of the Environmental Sustainability Construct Variables.

```
> t.test(VAR1.1,VAR1.2)

        Welch Two Sample t-test

data:  VAR1.1 and VAR1.2
t = 0.75262, df = 123.73, p-value = 0.4531
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.2328453  0.5185596
sample estimates:
mean of x mean of y
 3.539683  3.396825

> t.test(VAR1.1,VAR1.3)

        Welch Two Sample t-test

data:  VAR1.1 and VAR1.3
t = -1.0059, df = 123.67, p-value = 0.3164
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.5652895  0.1843372
sample estimates:
mean of x mean of y
 3.539683  3.730159

> t.test(VAR1.3,VAR1.2)

        Welch Two Sample t-test

data:  VAR1.3 and VAR1.2
t = 1.8031, df = 124, p-value = 0.0738
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.0325722  0.6992389
sample estimates:
mean of x mean of y
 3.730159  3.396825
```

Figure 22. t-test Perceived Environmental Sustainability Based on Blockchain Knowledge.

```
>  t.test(blockchain$knowledge_blockchain, environment$row_mean)

        Welch Two Sample t-test

data:  blockchain$knowledge_blockchain and environment$row_mean
t = -4.8831, df = 117.89, p-value = 3.315e-06
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.2716806 -0.5378432
sample estimates:
mean of x mean of y
 2.650794  3.555556
```

Figure 23. Summary of the Societal Sustainability Construct Variables.

```
> summary(society)
     VAR2.1          VAR2.2          VAR2.3
 Min.   :1.000   Min.   :1.000   Min.   :1.000
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.000
 Median :4.000   Median :4.000   Median :3.000
 Mean   :3.698   Mean   :3.698   Mean   :3.508
 3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:5.000
 Max.   :5.000   Max.   :5.000   Max.   :5.000
```

Figure 24. t-test of the Societal Sustainability Construct Variables.

```
> t.test(VAR2.1,VAR2.3)

        Welch Two Sample t-test

data:  VAR2.1 and VAR2.3
t = 1.017, df = 118.15, p-value = 0.3112
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.1804080  0.5613604
sample estimates:
mean of x mean of y
 3.698413  3.507937

> t.test(VAR2.2,VAR2.3)

        Welch Two Sample t-test

data:  VAR2.2 and VAR2.3
t = 1.0322, df = 116.19, p-value = 0.3041
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.1750180  0.5559703
sample estimates:
mean of x mean of y
 3.698413  3.507937

> t.test(VAR2.1,VAR2.2)

        Welch Two Sample t-test

data:  VAR2.1 and VAR2.2
t = 0, df = 123.81, p-value = 1
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.3206961  0.3206961
sample estimates:
mean of x mean of y
 3.698413  3.698413
```

Figure 25. t-test Perceived Societal Sustainability Based on Blockchain Knowledge.

```
> t.test(blockchain$knowledge_blockchain, society$row_mean)

        Welch Two Sample t-test

data:  blockchain$knowledge_blockchain and society$row_mean
t = -5.5326, df = 111.68, p-value = 2.106e-07
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.3365793 -0.6316747
sample estimates:
mean of x mean of y
 2.650794  3.634921
```

Figure 26. Summary of the Economic Sustainability Construct Variables.

```
> summary(economy)
     VAR3.1          VAR3.2          VAR3.3
 Min.   :1.000   Min.   :2.000   Min.   :1.000
 1st Qu.:3.000   1st Qu.:3.000   1st Qu.:3.500
 Median :4.000   Median :4.000   Median :5.000
 Mean   :3.762   Mean   :4.095   Mean   :4.206
 3rd Qu.:5.000   3rd Qu.:5.000   3rd Qu.:5.000
 Max.   :5.000   Max.   :5.000   Max.   :5.000
```

Figure 27. t-test of the Economic Sustainability Construct Variables.

```
> t.test(VAR3.1,VAR3.2)

        Welch Two Sample t-test

data:  VAR3.1 and VAR3.2
t = -1.9439, df = 120.35, p-value = 0.05425
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.672841258  0.006174591
sample estimates:
mean of x mean of y
 3.761905  4.095238

> t.test(VAR3.1,VAR3.3)

        Welch Two Sample t-test

data:  VAR3.1 and VAR3.3
t = -2.4576, df = 123.62, p-value = 0.01537
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.80239918 -0.08648971
sample estimates:
mean of x mean of y
 3.761905  4.206349

> t.test(VAR3.2,VAR3.3)

        Welch Two Sample t-test

data:  VAR3.2 and VAR3.3
t = -0.669, df = 122.25, p-value = 0.5048
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.4398893  0.2176671
sample estimates:
mean of x mean of y
 4.095238  4.206349
```

Figure 28. t-test Perceived Economic Sustainability Based on Blockchain Knowledge.

```
> t.test(blockchain$knowledge_blockchain, economy$row_mean)

        Welch Two Sample t-test

data:  blockchain$knowledge_blockchain and economy$row_mean
t = -7.8969, df = 106.92, p-value = 2.683e-12
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.714380 -1.026361
sample estimates:
mean of x mean of y
 2.650794  4.021164
```

Figure 29. Summary of the Willingness to Switch Construct Variables.

```
> summary(switch)
     VAR4.1          VAR4.2          VAR4.3          VAR4.4
 Min.   :1.000   Min.   :1.000   Min.   :1.000   Min.   :1.000
 1st Qu.:4.000   1st Qu.:3.000   1st Qu.:2.000   1st Qu.:2.000
 Median :5.000   Median :3.000   Median :3.000   Median :3.000
 Mean   :4.222   Mean   :3.476   Mean   :3.016   Mean   :3.317
 3rd Qu.:5.000   3rd Qu.:4.000   3rd Qu.:4.000   3rd Qu.:4.000
 Max.   :5.000   Max.   :5.000   Max.   :5.000   Max.   :5.000
```

Figure 30. t-test of the Dependency of VAR4.4 on Age.

```
> t.test (age, VAR4.4)

        Welch Two Sample t-test

data:  age and VAR4.4
t = 16.298, df = 63.241, p-value < 2.2e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 22.71479 29.06299
sample estimates:
mean of x mean of y
 29.20635   3.31746
```

Figure 31a. t-test of the Willingness to Switch Construct Variables.

```
> t.test(VAR4.1,VAR4.2)

        Welch Two Sample t-test

data:  VAR4.1 and VAR4.2
t = 4.4741, df = 123.72, p-value = 1.717e-05
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 0.4159875 1.0760760
sample estimates:
mean of x mean of y
 4.222222  3.476190

> t.test(VAR4.1,VAR4.3)

        Welch Two Sample t-test

data:  VAR4.1 and VAR4.3
t = 6.5654, df = 121.71, p-value = 1.341e-09
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 0.842602 1.570096
sample estimates:
mean of x mean of y
 4.222222  3.015873

> t.test(VAR4.1,VAR4.4)

        Welch Two Sample t-test

data:  VAR4.1 and VAR4.4
t = 4.5486, df = 115.93, p-value = 1.337e-05
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 0.5107957 1.2987281
sample estimates:
mean of x mean of y
 4.222222  3.317460
```

Figure 31b. t-test of the Willingness to Switch Construct Variables.

```
> t.test(VAR4.2,VAR4.3)

        Welch Two Sample t-test

data:  VAR4.2 and VAR4.3
t = 2.5559, df = 119.95, p-value = 0.01184
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 0.1037259 0.8169091
sample estimates:
mean of x mean of y
 3.476190  3.015873

> t.test(VAR4.2,VAR4.4)

        Welch Two Sample t-test

data:  VAR4.2 and VAR4.4
t = 0.81171, df = 113.29, p-value = 0.4187
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.2286796  0.5461400
sample estimates:
mean of x mean of y
  3.47619   3.31746

> t.test(VAR4.4,VAR4.3)

        Welch Two Sample t-test

data:  VAR4.4 and VAR4.3
t = 1.4345, df = 121.9, p-value = 0.154
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.1145908  0.7177654
sample estimates:
mean of x mean of y
 3.317460  3.015873
```

Figure 32. Willingness to Switch Based on Availability of Cryptocurrency Assets.

```
> t.test(blockchain$knowledge_blockchain, switch$row_mean)

        Welch Two Sample t-test

data:  blockchain$knowledge_blockchain and switch$row_mean
t = -4.912, df = 108.05, p-value = 3.223e-06
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.2030300 -0.5112557
sample estimates:
mean of x mean of y
 2.650794  3.507937
```

Figure 33. t-test Willingness to Switch Based on Blockchain Knowledge.

```
> t.test(blockchain$knowledge_blockchain, switch$row_mean)

        Welch Two Sample t-test

data:  blockchain$knowledge_blockchain and switch$row_mean
t = -4.912, df = 108.05, p-value = 3.223e-06
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.2030300 -0.5112557
sample estimates:
mean of x mean of y
 2.650794  3.507937
```

Figure 34. Pearson Correlation Test Between Three Pairs of Construct Indicators.

```
> cor(environment$row_mean,switch$row_mean)
[1] 0.3361794
>
> cor(society$row_mean,switch$row_mean)
[1] 0.6048942
> cor(economy$row_mean,switch$row_mean)
[1] 0.2824504
>
```

Appendix B

Figure 35. Histogram VAR1.1.

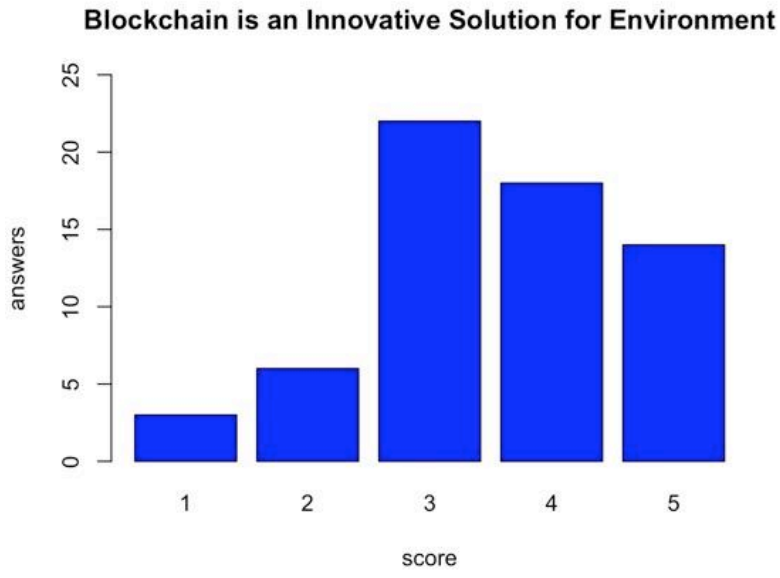


Figure 36. Histogram VAR1.2.

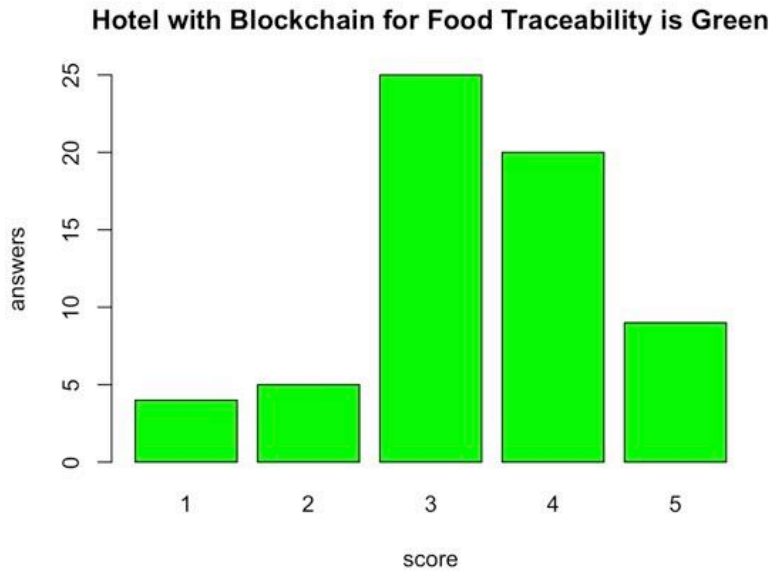


Figure 37. Histogram VAR1.3.

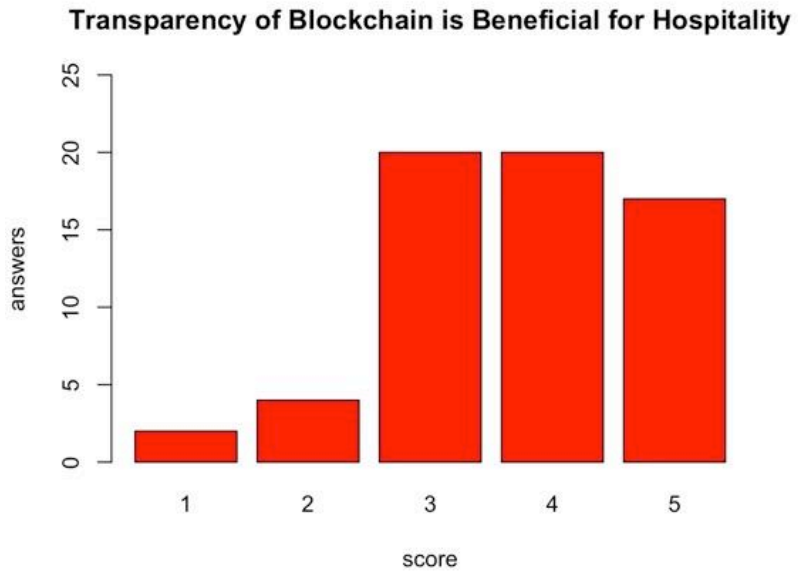


Figure 38. Histogram VAR2.1.

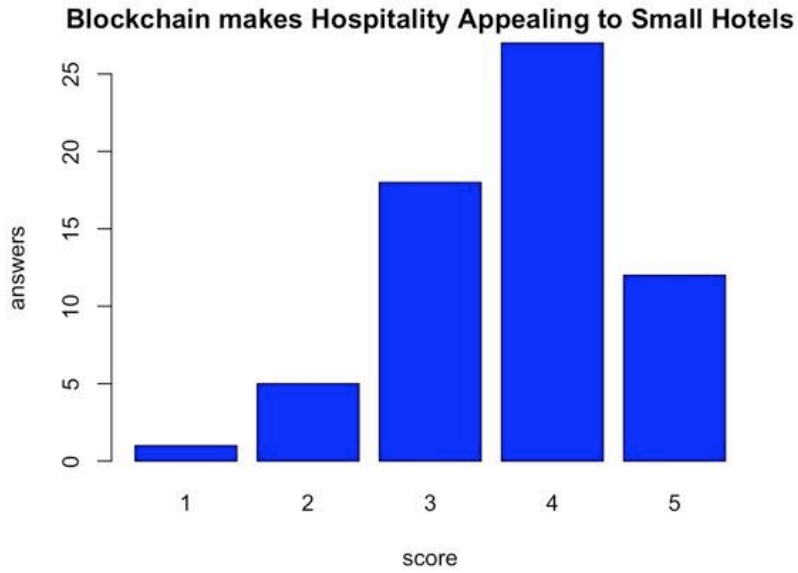


Figure 39. Histogram VAR2.2.

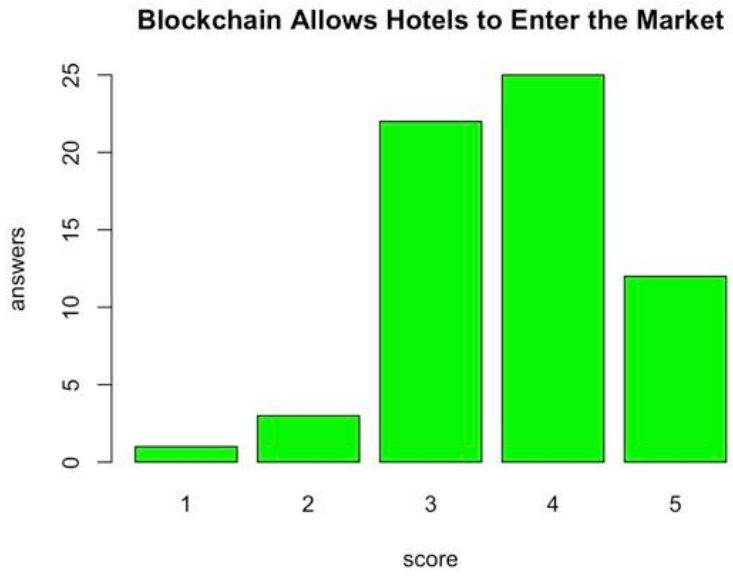


Figure 40. Histogram VAR2.3.

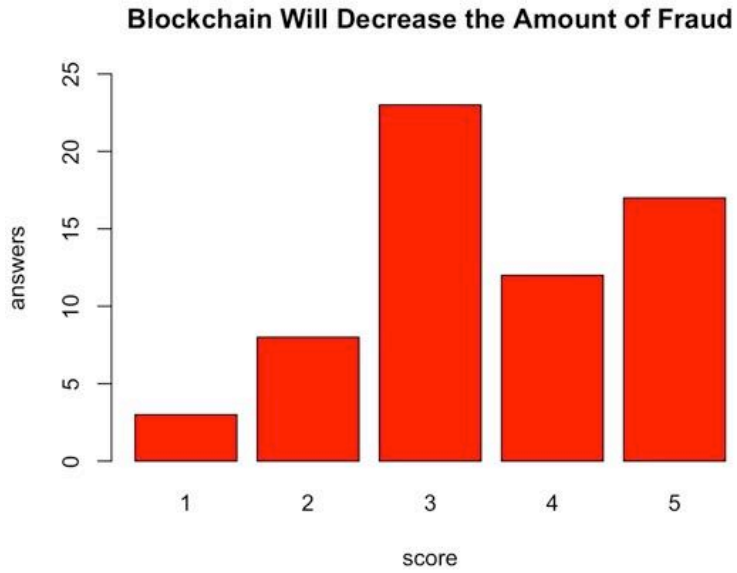


Figure 41. Histogram VAR3.1.

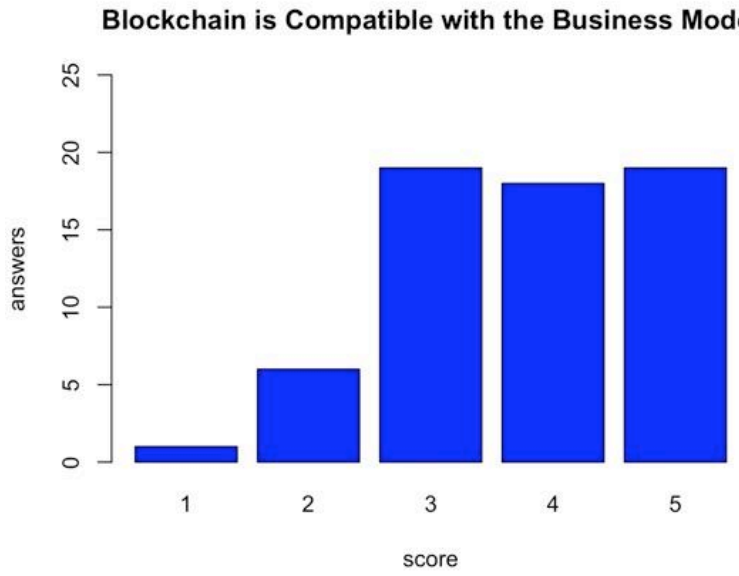


Figure 42. Histogram VAR3.2.

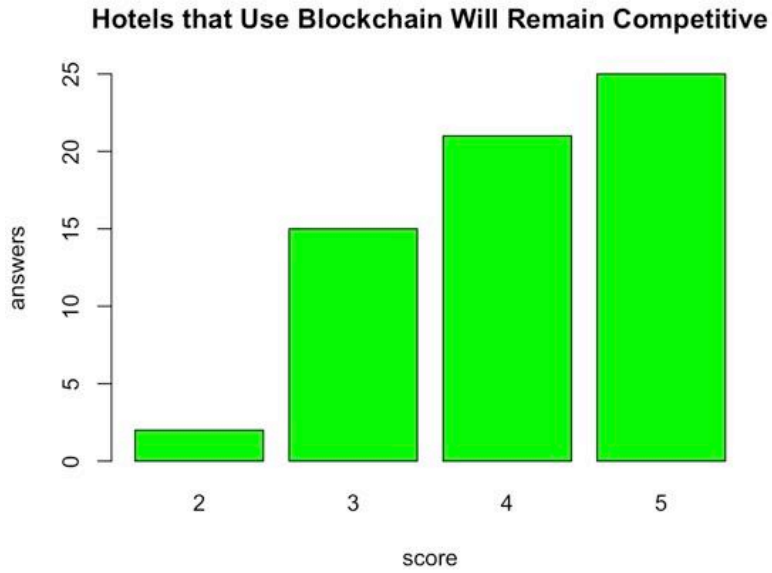


Figure 43. Histogram VAR3.3.

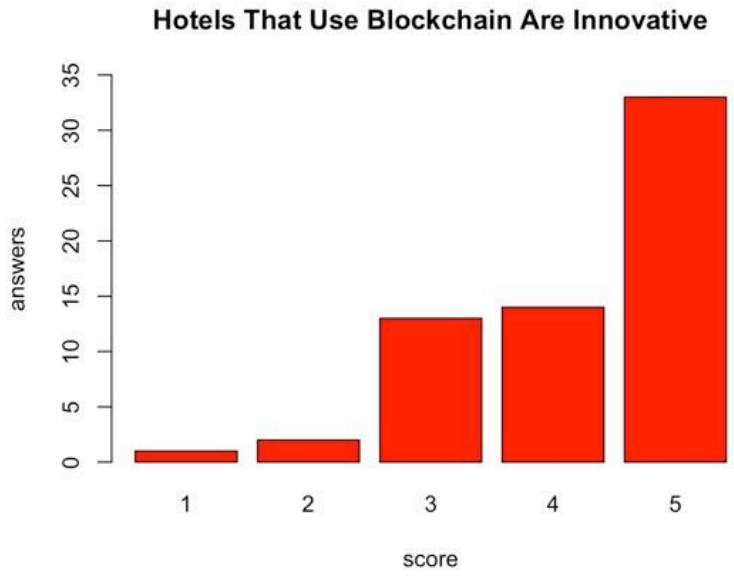


Figure 44. Histogram VAR4.1.

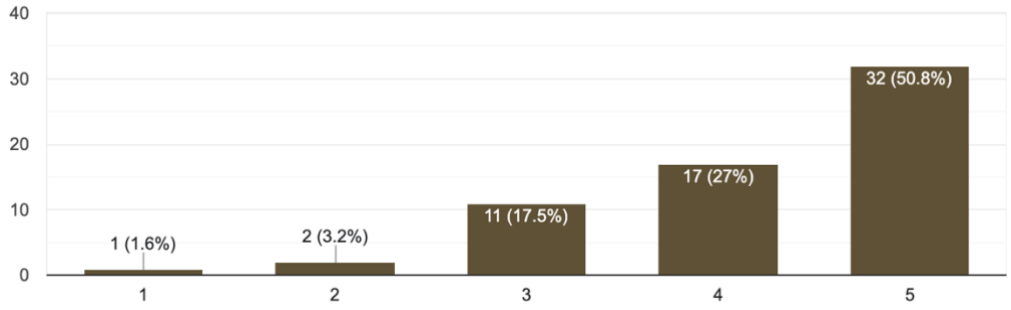


Figure 45. Histogram VAR4.2.

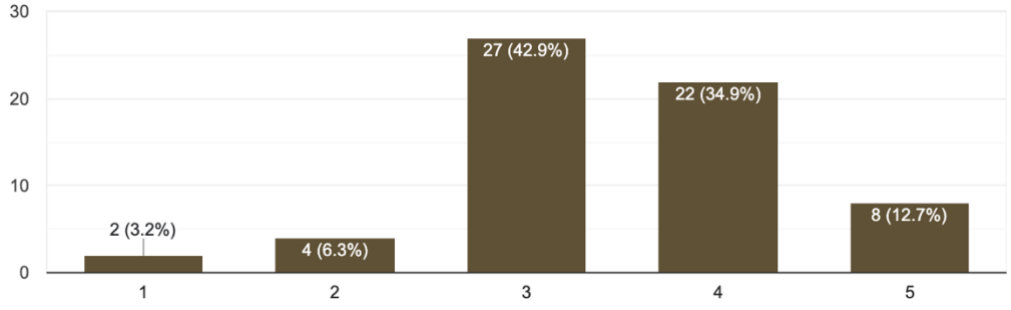


Figure 46. Histogram VAR4.3.

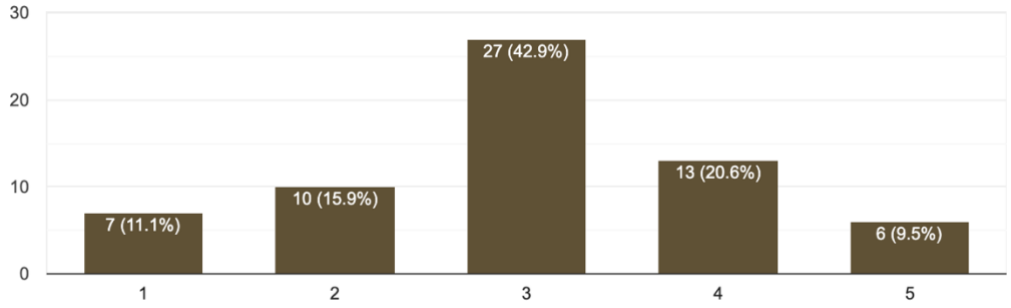


Figure 47. Histogram VAR4.4.

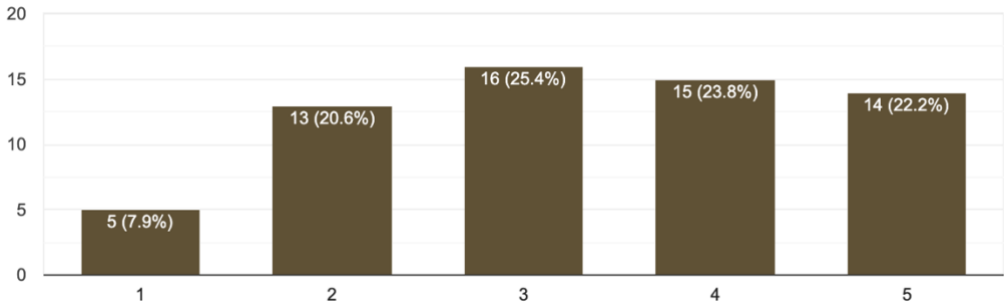
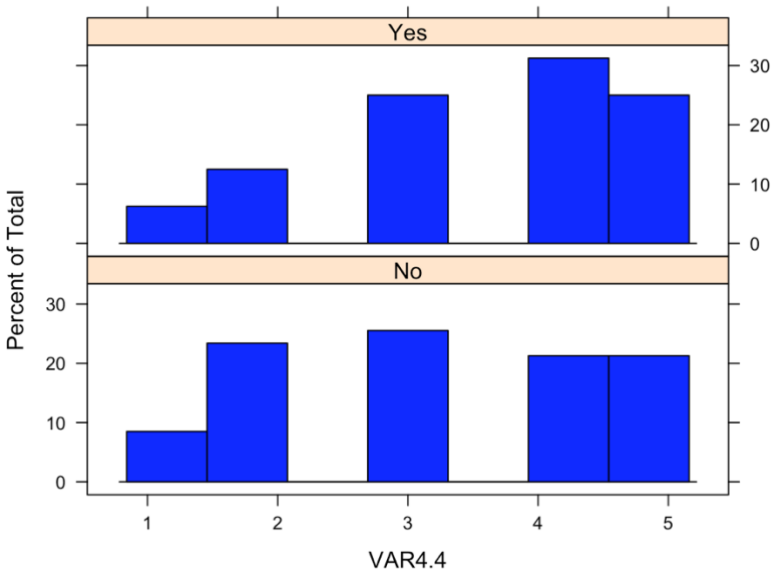


Figure 48. Histogram VAR4.4 Based on Availability of Crypto Assets.



Appendix C

Survey in Google Froms:

https://forms.gle/jzm28Z9mLt7V3rsM7

Excel Sheet Containing the Results of the Survey:

https://docs.google.com/spreadsheets/d/1hDzTqUx8RZG9aF4SQ9NfvgMkoMub9oNcZpK30_h8eH0/edit#gid=2088661228