Current State of Blockchain Adoption within Industry Through The Lens of Diffusion Of Innovations

by

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(Under the Direction of In Kee Kim)

Abstract

The objective of this research is to gain a comprehensive understanding of the current landscape of blockchain within industry. Despite the immense hype surrounding blockchain, there seems to be a significant gap between its theoretical potential and its practical implementation. This thesis endeavors to illuminate this paradox by engaging in in-depth interviews with thirty-one distinguished experts within the blockchain industry. Through the lens of Everett Rogers' influential Diffusion of Innovations theory, this study seeks to unearth valuable insights. These findings will not only lay a robust foundation for future optimization, but also pave the way for informed recommendations.

Index words: Artificial Intelligence, Blockchain, Cryptocurrency, Diffusion of Innovations

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Chapter 1

Introduction & Literature Review

A timeless proverb reminds us that "there is nothing new under the sun." However, in ancient times, society lacked access to the transformative potential of rapidly advancing technology. Various innovations by ways of art, media, sports, technology, and everyday life present themselves throughout the timeline of history. Successful examples of innovations include Thomas Edison's light bulb, Mark Zuckerberg's social media "Facebook"-which lead to the development of the wide-spanning database "Meta", and Steve Jobs' development of the ever evolving multi-generational iPhone. Innovations are proven as either successful or not based on society's willingness to recognize its "need" for them. Either rejection or adoption/adaptation generate, with emphasis on the weight of an innovations value. The study of such ideas leads the viewer to its "diffusion of innovation". This essay delves into the expansive realm of blockchain technology. The diffusion theory, introduced by Everett Rogers in his fifth edition of "Diffusion of Innovations" gives blockchain study a full circle moment in understanding this innovation's dynamics. The exploration will encompass both its triumphs and challenges, communicating it's nuanced perspective on its evolution.

1.1 Diffusion of Innovations

To understand the correlation between investigating blockchain and the dynamics of the theory, the theory must first be broken down. Diffusion is defined as the communication of an innovation through certain channels by members of a social system over time. An innovation (idea, practice, or object) targets "newness" by an individual or other unit of adoption. The newness factor disregards the time the innovation was first discovered or "objectively" born. Perceived "newness" of an idea for an individual determines the reaction to it. Innovation adoption is a matter of favorable or unfavorable attitudes towards an innovation, or the acceptance or rejection of it. Adoption of the innovation has everything to do with presentability, relative advantage, compatibility, timing, target group and so on. For example, the case study of boiling water in a Peruvian Village presented in Rogers diffusion theory is an innovation that failed. The public health service of Peru had the initial idea of improving villagers' health and lengthening their lives by knowing that waterborne diseases could greatly be reduced by boiling water prior to consumption. At the acknowledgement of failure, the question "how could this be?" explodes into researchers minds. The idea was to restore and cyclically generate healthy outcomes to improve quality of life. Objectively, the innovation presents itself as a wonderful implementation. The issue with this objective observation lies in the fact that the innovators upheld the "innovation-oriented" mindset over "client-oriented"-increasing its rate of failure far above the rate of success.

Further exploration on its failure was due to ignorance of cultural norms. Rogers writes "An important factor regarding the adoption rate of an innovation is its compatibility with the values, beliefs, and past experiences of individuals in the social system. Nelida [local Peruvian health worker] and her superiors in the public health agency should have understood the hot-cold belief system, as it is found throughout Peru (and in most nations of Latin America, Africa, and Asia). The indigenous knowledge system caused the failure of the

diffusion effort for water boiling in Los Molinas" [19]. There was a stigma (and increased rate of absolute failure) against boiled water from the beginning. It was perceived as culturally inappropriate. To further elaborate on the hot-cold belief system, Rogers put it into simple terms stating "local tradition links hot foods with illness. Boiling water makes water less "cold" and hence appropriate only for the sick. If a person is not ill, he or she is prohibited by village norms from drinking boiled water" [19]. This information was a critical factor the health workers should have known. The entirety of this two year water-boiling campaign in Peru lead to defeated efforts on the basis of not being culturally aware. Ignorance, in this case, was not bliss.

In a world where modern technology is continually developing, the diffusion of blockchain technology is underway. The advantage it has as a possible global repository for the reliance of recording and tracking transactions amongst other networks could be revolutionary. Throughout blockchain, there is an outsourcing of points of verification in the recording of purchases, transfers, contract agreements and so on. Original, unique codes are generated using encryption to protect the data stored in each block, yet once uploaded, an edit to the original block cannot be tampered with or falsified. A chain-of-edit is possible to perform, but not the change of original data. The launching of blockchain came to pass in 2009, with "Bitcoin" being its first application. The diffusion of it thereof, has yet to skyrocket in current times. For example, the dollar (involving both wireless and physical tender) is still America's nationwide currency. Blockchain, in and of itself, is not limited to solely Bitcoin-as it is a database for various information records, so there are other advantageous and steadily growing uses to its platform [16].

In addition to the current investigation of blockchain's success rate in society, an important element to note is how "diffusion adoption" is an extremely social process. As stated previously, a "first release" of Bitcoin as the connection to blockchain launched in 2009, but despite advertisement and the few years of launch, the world has not yet transitioned to

cryptocurrency entirely circa 2023 [16]. Society's adoption of blockchain will battle against the test of time. Blockchain must also prove its credibility-its current counterargument to adoption. Furthermore, it must prove its relative advantage (where an idea is perceived as better than the idea it supersedes), and compatibility to its target audience. Diffusion adoption involves interpersonal communication relationships as well- which are simply face to face exchanges between two or more individuals. Without interpersonal exchanges taking place, an idea would have a lesser likelihood of individual or societal acceptance since such exchanges boost persuasion efforts. This factor is especially a vantage point for success if links such as socioeconomic status, education or another means of personal connection are created between the individuals in discussion.

Along these lines, the benefit of investigating blockchain is the fact that it is a media channel. Various interlinked pathways of blockchain's media channels include LinkedIn, YouTube, Blockchain Infuencers and so on. Rogers notes, "Mass media channels are usually the most rapid and efficient means of informing an audience of potential adopters about the existence of an innovation-that is, to create awareness-knowledge. Mass media channels are all those means of transmitting messages that involve a mass medium, such as radio, television, newspapers and so on, which enable one or few individuals to reach an audience of many" and "in addition to mass media and interpersonal communication channels, interactive communication via the Internet has become more important for the diffusion of certain innovations in recent decades" [19].Rogers emphasized the importance of the Internet because it has an advantage for mass outreach and promotion. The audience that can be targeted reaches eyes and ears beyond just a physical encounter.

Rogers goes on to acknowledge innovativeness and its "adopter categories". Addressing the breakdown of these categories expands the understanding of where blockchain fits into the system. Rogers states "when the number of individuals adopting a new idea is plotted on a cumulative frequency basis over time, the resulting distribution is an S-shaped curve"

[19].The “S” gives visualization to the adoption rate of innovation, usually starting with a few (the innovators), then a steady climb over time (a month or a year, for example), then eventually, a leveling as the S-shaped curve reaches its asymptote-thus completing the diffusion process. With the current investigation of blockchain underway, the technology’s “S” graph can only display so much information-being launched less than two decades ago. There is a constant update of information to upload to the graph over time in this rapidly expanding technology based society.

Moreover, an imperative factor on blockchain’s success rate or failure of adoption has a great deal to do with which social system its introduced to, how, and by whom. Reflect on how many fast food companies will sponsor professional athletes, talented musicians and artists, or well known actors for sale promotion through advertisement. The same technique can be applied to this case. If promoted by a trusted, popular, or highly accepted member of society, the rate of adoption will be much more fluid. A sort of “social-influence”. Notice how trends rapidly generate, and then retract over time, with the possibility of climbing back to popular demand. Examples such as “Crocs” shoes, fanny packs, and flip phones fluctuate in social acceptance and popularity throughout history’s timeline.

Introducing: the effects and importance of opinion leaders and change agents. Opinion leadership is defined as ”the degree to which an individual is able to influence other individuals’ attitudes or overt behavior informally in a desired way with relative frequency. Opinion leadership is earned and maintained by the individuals technical competence, social accessibility, and conformity to the systems norms” [19]. Any ”well known” names come to mind? Innovations are greatly impacted by influence, and opinion leaders exert influence. A change agent is ”an individual who influences clients’ innovation-decisions in a direction deemed desirable by a change agency” [19]. They’re commonly professionals with a university degree in a technical field. Later on, the impact of a change agent in blockchain technology will be emphasized, because both opinion leaders and change agents play a significant role in

diffusion.

1.2 Blockchain

This paper aims to present the current state of blockchain adoption within industry, highlight what is being done and what isn't, and discuss the associated issues and benefits of deploying this technology. To gather insights, interviews were conducted with industry experts from various domains who shared their perspectives on blockchain. The intention is to provide information and foster understanding about blockchain adoption, just as I have gained throughout this research. The question of whether blockchain is merely a buzzword or lives up to its claims remains.

An oversimplified definition of blockchain is an immutable, decentralized, append-only database. This in itself is a tricky definition, as the description is a bit convoluted. Let's try to break it down further. Blockchain gets its name from the notion that there are multiple blocks linked together to form a chain. The reason why the chain formation occurs is because individual blocks work as a timestamp and always follow a specific block, since it is attached by that last blocks previous hash code (Note: with the exception of the "Genesis Block", which is defined as the initial starting block) [28]. These blocks are the storing of data and blockchain as a whole is another medium of storage, such as a transaction log. The data within the blocks can be of any data type to be stored on a database. Essentially, any data that can be stored in a traditional database can also be stored on the blockchain.

Now the question arises: what sets blockchain apart from any other database? The simple answer lies in its immutability, decentralization, and the inherent zero-trust mechanism embedded within the technology [4]. Notice how persuasive this innovation already presents itself. In the light of Diffusion of Innovation theory, blockchain promotes itself on the basis of having a greater perceived relative advantage over traditional databases-in effect, superseding

them. Rogers states "The greater the perceived relative advantage, the more rapid its rate of adoption will be" [19]. Acknowledgment for blockchain's accomplishments that set it apart boost it's perception of relative advantage, but as stated in theory, it's newness also presents it's current faults or "uncertainties". In comparison, traditional databases allow the creation, reading, updating, and deletion of data, often referred to as CRUD operations [24]. Blockchain does not support all of these functions (specifically, delete and update) in order to adhere to a zero-trust policy and provide a decentralized and immutable technology. Zero-trust policy is a cybersecurity strategy that allows for users to be constantly verified and not maintain any level of trust to run / work with one another. So in essence, it is the assumption that everyone is untrustworthy, but there are mechanisms set in place to keep all parties safe from one another, whether within or outside the organization. The "other side of the coin" is clear about blockchain's functions and current limitations displaying strengths and weaknesses.

At first glance, having fewer features than a typical database may seem like a drawback when adopting this alternative technology. However, that is not necessarily the case. Instead of allowing the deletion or update of blocks already uploaded onto the blockchain network, a node accessing the blockchain network must add an additional block to record any amendments or changes made to the existing information. This is because the previous copies on the blockchain cannot be tampered with, ensuring the immutability of the transaction log once verified. When you add data to the blockchain, you cannot remove or modify it. At the heart of it; to update data, new versions must be created, forming a complete record of the adjusted data. These versions display the timestamps indicating when the data was changed, who made the changes, and a comparison to its previous state. By excluding these two features (i.e., delete and update) from blockchain technology, a sense of security and trust is established for users participating on the network. This design also facilitates automatic auditing by maintaining a log of the data's provenance and background, thus verifying

its authenticity.

Here lies what's prided as a technology cluster. Rogers notes that "a technology cluster consists of one or more distinguishable elements of technology that are perceived as being closely interrelated. Some change agencies promote a "package" of innovations because they find that the innovations are thus adopted more rapidly" [19]. Though not necessarily a package of separate innovations, essential elements for personal, business, or social use within blockchain are provided. The "package deal" a consumer navigates is the benefit of a multi-use database through the avenues of original work, allowance of timestamped changes and visualization of through whom, logging information, and more. The advantage of this alternative technology is that the blockchain itself cannot be altered without detection, as all changes are appended to the end of the chain and require the approval of a 51% majority through a consensus mechanism. This process ensures that the technology operates with zero-trust, eliminating the need for reliance on others, third-parties, or a central authority. This serves as a significant benefit of using blockchain over traditional programs.

There are several advantages that companies can gain by leveraging blockchain technology for their businesses. The decentralization of blockchain offers higher security, transparency, auditability, and immutability. Choosing blockchain over a typical centralized database provides the benefit of a decentralized governance system, giving users control over their assets. The security provided by blockchain stems from its inherent resistance to data manipulation. Blockchain innovators support the "client-oriented" mindset based on the thought given to protecting and suiting consumers.

Additionally, the consensus mechanism, commonly known as mining, cross-references and verifies the blockchain through multiple logs of "original copies," further enhancing security. This makes it significantly more difficult for hacks to occur since a consensus of the majority of nodes is required to verify a pending transaction before it can be executed. This effectively prevents issues such as the "double-spend" problem, where a digital currency

or asset is duplicated and used more than once. A highly suitable example of the double-spend issue is the usage of checks fraudulently-where someone would use a set amount of finances twice prior to processing. Before the check would bounce, said person would write a check for a hundred dollars at one store only to go to the next and write a check for the same set hundred dollars-essentially spending a ghost amount of money before getting caught. Transparency is another key feature of blockchain as all transactions are visible to all permissioned participants on the network, facilitating auditing capabilities.

There are always two sides to a coin, and it's important to acknowledge the common drawbacks that have hindered the expected widespread prevalence of blockchain-specifically through the lens of "uncertainty". Uncertainty, as defined by Rogers, is "the degree to which a number of alternatives are perceived with respect to the occurrence of an event and the relative probability of these alternatives". He goes on to note "uncertainty implies a lack of predictability, of structure, of information" [19] Skepticism, push-back, and even competition challenging a new idea is expected. Rogers states "diffusion is a special type of communication in which the messages are about a new idea. This newness of the idea in the message content gives diffusion its special character. The newness means that some degree of uncertainty is involved in diffusion" [19]. Blockchain's "uncertainties" include the lack of user-friendliness, poor interoperability, and concerns about security risks associated with adopting a new technology that hasn't been extensively implemented. Other factors contributing to its limited adoption include scalability challenges, cost implications, and a relatively low number of companies embracing blockchain. These issues stem from the inherent trade-offs required to maintain security and decentralization, as well as the fact that blockchain technology is still in its early stages of development. Rogers elaborated on the consequences of innovations. Consequences are the changes that occur as a result of individual or societal adoption or rejection. Three classifications of consequences are 1) desirable versus undesirable, 2) direct versus indirect, and 3) anticipated versus unanticipated.

Obviously, in a perfect world, blockchain would only have desirable, anticipated, and direct expectations.

Circling back to change agents and their affects, Rogers notes a critical point saying "change agents usually introduce innovations into a client system that they expect will have consequences that will be desirable, direct, and anticipated. But often such innovations result in at least some unanticipated consequences that are indirect and undesirable for the systems members" [19]. One of the main reasons we don't see many companies running their data on a blockchain is because they likely encounter significant challenges or perceive risks that outweigh the potential benefits-a consequence of "newness". It is crucial to understand the specific problems that these corporations are trying to mitigate by not utilizing this emerging technology.

As the technology continues to evolve and mature, we may see these challenges being addressed, leading to greater adoption and integration of blockchain solutions in various industries. Another encouraging factor to an innovation as such comes from the creator of Diffusion of Innovations theroy himself. Rogers states "A technological innovation embodies information and thus reduces uncertainty about cause-effect relationships in problem solving" [19]. Thankfully, blockchain is technology based, launching into public use a technology where information can continually be collected and corrected over time, reducing uncertainty for consumers. In contrast, an innovation shed in light separate from technology would generate more uncertainty due to lack of information. To better define "information" in Diffusion theory context (as opposed to an extremely generic term), Rogers defines it as "a difference in matter-energy that affects uncertainty in a situation where a choice exists among a set of alternatives" [19].Blockchain may be "new" with uncertainties outweighing "older more seemingly reliable innovations", but the foundations on which it's being established bring the consumer back to the acknowledgment of its promising potential of relative advantage.

To delve deep into the importance of the information to be presented later, it is essen-

tial to understand the context and critical aspects of why blockchain deserves study. While blockchain technology has been around for some time, its popularity surged with the emergence of controversial cryptocurrencies like Bitcoin in 2009 [16]. Here, we will focus on the underlying technology itself - blockchain - and its potential and hindrances for industry adoption. It has become a buzzword with numerous tech companies investing in research and development.

In 2017, Synechron, a global digital consulting firm, conducted a survey involving over 200 high-ranking professionals from the financial services sector, including business and IT decision-makers. Participants from the United States, United Kingdom, and various European countries revealed that 67.4% of senior-level respondents were actively engaging in blockchain technology, and 94% believed their boards were invested in developing blockchain projects [17]. Interestingly, in 2022, Rapid Innovation, a blockchain app development company, surveyed 200 executives from Fortune 500 companies and found the same percentage, with 94% of participants planning to leverage blockchain technology in their enterprises. While some companies are actively exploring blockchain, others remain cautious and prefer a second-mover advantage, observing and learning from the implementation efforts of their peers [18]. Again, the "uncertainty" factor Rogers broke down presents itself as a result of blockchains "newness".

A key factor to innovation success is networking and recognition. Blockchain has gained significant attention in academia, and many prestigious universities are actively involved in researching and teaching this technology. Renowned institutions such as the Massachusetts Institute of Technology (MIT), Indian Institute of Technology (IIT), National University of Singapore, University of California (UC)-Berkeley, ETH Zurich, Oxford University, Stanford University, and The University of New South Wales (UNSW) in Sydney offer comprehensive blockchain education and initiatives. Rogers diffusion theory term "trialability" is an attribute being implemented through the universities currently. This is as a result of in-

stitutions generating activity involvement with the blockchain world prior to adopting it as a whole. Trialability is "the degree to which an innovation may be experimented with on a limited basis" [19].It's important to note that this list is not exhaustive, and there are numerous other universities around the world engaged in blockchain-related education initiatives. A second attribute experimented with due to university exposure is the "observability" within blockchain. Rogers states how observability is "the degree to which the results of an innovation are visible to others" [19]. If prestigious colleges implement blockchain in their systems, it would boost blockchain's credibility. Prestigious colleges have their image on the line, with competing colleges or nations watching, so it cannot be concluded that they're careless with innovation adoption systems. If blockchain is adopted overall, blockchain's observability would be exposed in a positive light.

To further promote blockchain research and educate students about cryptocurrency, blockchain companies have been generously donating millions of dollars' worth of crypto to colleges and universities. However, universities could attract even more donations by improving their publicity and communication regarding their acceptance of crypto donations. Some notable donations include IOHK donating $500,000 worth of Cardano (ADA) to the University of Wyoming, Ripple committing $50 million to thirty universities through its University Blockchain Research Initiative (UBRI), Block.one donating $3 million to Virginia Tech, Nikolai Mushegian donating $6 million worth of MakerDAO (MKT) to Carnegie Mellon University, and the Echolink Foundation donating $50,000 worth of Bitcoin to UC-Berkeley. These contributions aim to support blockchain research, establish talent hubs for software engineers, and foster innovation in the blockchain space within educational institutions [9].

After conducting extensive research through literature reviews, white papers, and online forums, I came to the realization that in order to truly understand the current impact of blockchain, it is crucial to speak directly with individuals within companies that have implemented this technology. In studying blockchain through the lens of Diffusion of Innovation,

I was again reminded of how "social" diffusion is. Rogers notes "...dependence on the experience of near peers suggests that the heart of the diffusion process consists of the modeling and imitation by potential adopters of their network partners who have previously adopted. Diffusion is a very social process that involves interpersonal communication relationships" [19].While the potential benefits and solutions that blockchain offers can be discussed, its true value lies in its adoption by the majority. Ultimately, it is the people who give meaning to technology, and I had the opportunity to glean insight to these "network partners" who have already adopted blockchain.

The key topics that need to be addressed are: 1) why blockchain is facing barriers to adoption, 2) what problems this technology has successfully solved, 3) what challenges have emerged, and 4) whether the overall outcome of using blockchain has been worthwhile. I am not interested in engaging with individuals who simply attach the term "blockchain" to their company in order to capitalize on the hype and recognition without providing tangible goods or services. It is easy to delve into theoretical discussions all day, but without engaging with potential clients who would consider implementing blockchain, we will make no progress in terms of adoption and fail to convince anyone of its value.

Further expansion on blockchain implementations and funding have promising future goals, but there are current effects of blockchain's reputation. As a positive, according to Statistica (2023), "worldwide spending on blockchain solutions is projected to grow from $4.5 billion in 2020 to an estimated $19 billion by 2024" [21]. This is just a projection for now, though. However, it is important to note that there has been a decrease in funding for blockchain projects due to regulatory concerns and an increase in fraudulent activities within the crypto world. Just as Rogers mentions "It should not be assumed that the diffusion and adoption of all innovations are necessarily desirable" [19].One of the main issues is the interchangeability of terms, where certain companies, such as the infamous FTX, and cryptocurrencies are often mistakenly associated with blockchain as a whole.

This confusion has led to a negative reputation for blockchain technology. Consequently, investors have become more hesitant to fund blockchain-based projects, causing a decline in available capital. These factors have contributed to a negative perception of the underlying cryptocurrency technology, blockchain. Despite these challenges, individuals and companies with a deeper understanding of the technology are still actively researching how blockchain can enhance their operations. They recognize the distinction between the negative publicity surrounding certain entities and the potential benefits that blockchain can offer.

Currently, there is a limited number of professionals with expertise in Web3, as blockchain operates under different principles compared to the Web2.0 space. Blockchain does not hold the adherent rules followed within the Web2.0 space making it a new beast to tame. This uniqueness poses a question regarding the actions and motivations of companies in the blockchain industry. Blockchain requires a different education versus the standard developers background. Because of this I question if this is due to blockchain being unreliable and not living up to what it claims to be. If so, is it apparent with utilizing this technology, or can it be the current lack of adoption from our side, and if this adoption is due to any typical reasons that innovative technology is hindered during its Hype Cycle. The Technology Hype Cycle was proposed by Gartner [11], one of the most accredited tech research consulting firms. As of 2022, blockchain and Web3 predictions on the cycle has blockchain wallets, decentralized applications and cryptocurrencies on the Slope of Enlightenment. Meaning more companies are funding pilots and more instances of the technology is being understood in how it can easily benefit corporations.

Based on the aforementioned research, the following are the most frequently mentioned business use cases of blockchain technology in efforts to highlight its potential for creative solutions in society.

1. Finance Sector: The primary and most cited use case for blockchain is in the realm of finance, particularly in relation to cryptocurrencies. Blockchain, as the underlying

technology of Bitcoin, offers a decentralized financial system that eliminates intermediaries and provides individuals with greater control and ownership of their money. This shift aims to rely on a zero-trust technology rather than placing trust solely in centralized financial systems. By decoupling the value of cryptocurrencies from fiat currencies, which rely on government backing, blockchain enables a more stable and independent financial ecosystem [23] [22] [26].

2. Supply Chain and Logistics: The inherent transparency and traceability provided by blockchain technology make it an ideal solution for supply chain and logistics challenges. Many companies, including Amazon, are exploring blockchain-based supply chain systems that enable efficient tracking and tracing of products. By leveraging blockchain's transaction provenance log, trust in third-party intermediaries can be minimized, leading to a seamless and secure operation for all stakeholders involved [14] [20] [6] [8] [12].

3. Gaming Industry: Blockchain technology is making significant inroads in the gaming world, particularly through the use of Non-Fungible Tokens (NFTs) [25]. NFTs represent unique assets that cannot be exchanged on a one-to-one basis with other assets. By utilizing blockchain-based NFTs, the gaming industry can combat black market exchanges and provide a legitimate way to buy and sell in-game characters and other digital assets. This shift from a play-to-earn model to a play-to-pay model introduces new opportunities for players to profit from their gaming activities [15].

These examples illustrate the diverse applications of blockchain technology, showcasing its potential to address industry-specific challenges and revolutionize existing systems and processes.

The origin of blockchain comes from the creation of Bitcoin. Blockchain is a technology developed by Satoshi Nakamoto, an infamous pseudonym for the creator or creators of Bitcoin

[16]. Blockchain was established as the technology that would serve as the purely peer-to-peer platform. This platform would cut financial third parties from being the layers preventing the double-spend problem. This blockchain peer-to-peer network is recorded by a hash-based proof-of-work (PoW) consensus mechanism. How prominently the diffusion theory presents itself within the veins of blockchain. As you can see here, two of Rogers diffusion terms rise to the surface: 1) social structure and 2) system norms coupled to diffusion. A social system is "a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and/or subsystems" [19].Blockchain's peer-to-peer platform completes or corrects their chains in order to accomplish their goal. Teams weave in communication structure: "the differentiated elements that can be recognized in the patterned communication flows in a system" [19].Consensus changes benefit majority adjustments but require communication to do so.

Within the links of perceived attributes of innovations (relative advantage, trialability and observability) already interwoven in the breakdown of blockchain, the fourth applicable attribute is complexity. Rogers defines complexity as "the degree to which an innovation is perceived as difficult to understand and use" [19].There are multiple components of blockchain to navigate. Transactions on the blockchain are the blocks themselves. A transaction is made-up of three components. The public key of the owner of the current block, the hash of the previous block and the signature of the previous blocks' owner. This signature and the previous blocks' owners public key is the verification. Double-spending still seems to be an issue with this mechanism, because say, the previous blocks' owner could digitally sign a transaction of a certain amount of electronic coins and do the same to another blocks' transaction, theoretically attempting to spend the same coins just transferred to another owner. This is why the peer-to-peer timestamp server is public to all nodes and the earliest transaction is the one that counts. "Currency is a first-to-file application" (ETH). Where

this trusted central authority, mint to verify is a transaction is valid. Here it is noted that the nodes do not rely on trusting the mint operation by its own claims, because then we run into the congruent dilemma of requiring a middle-man's verification. To obliterate a trusted party and relying on solely a technological standpoint, the transactions are publicly announced. And having the majority of the nodes participating in the network have to agree with the provenance of the transaction ledger. The "complexity" of blockchain is designed in a understandable way to the consumer.

The timestamp server is the answer to the publicly announced transactions. This timestamp with association to a particular widely published hash reinforces the linked chain and logs the transactions done at a particular time, since the data is verified since it was needed in creating that particular hash proving provenance. Privacy is now in question as to the framework requiring all transactions to be publicly announced. To ensure privacy in this schema, the public key is issued allowing anonymity. The public key is linked to all the transactions done. This anonymity is, in essence, the "tape" reported by stock exchanges. Crucial to mention, if a public key is found out and connected to an individual, then their identity is known and their past, present and future transactions are known and no longer private [16].

The white paper on the creation of Ethereum released in 2014 by Vitalik Buterin, the founder of Ethereum speaks on , "A Next-Generation Smart Contracts and Decentralized Application Platform". Ethereum was created for the second part of Bitcoin's technology: for applications other than exclusively money. In Buterin's ecosystem, what he intends for this shift is the creation of "smart contracts" as a normative: "What Ethereum intends to provide is a blockchain with a built-in fully fledged Turing-complete programming language that can be used to create 'contracts' that can be used to encode arbitrary state transition functions, allowing users to create any of the systems described above (systems which automatically move digital assets according to arbitrary pre-specified rules), as well as many others that

we have not yet imagined, simply by writing up the logic in a few lines of code" [3]. The benefit of building the smart contracts off of the Ethereum platform is that it offers the security that scripting off Bitcoin does not provide: Turing-complete, value-aware, state and blockchain-awareness.

Further applications notably mentioned are of savings wallets, crop insurance, a decentralized data feed, smart multi-signature escrow, cloud computing, peer-to-peer gambling, prediction markets and on-chain decentralized marketplaces. Limitations included scalability which is one that Bitcoin also faces. This is due to the amount of time it takes for the nodes needing to propagate through the network. Say that the size of the blockchain and its nodes increase, then it would take more time for a consensus. The other concern is the mention of collusion, where majority of the network could band together to cheat the system. This implementation of Ethereum provides unique potential to serve as a foundational layer for projects that are more than just currency.

There are different varieties of blockchain: public, private, and permission-based. Public, which is what most people currently work on, represents the blockchain that can be accessed and altered by anyone in the public. This pathway is considered to be fully decentralized. Private, on the other hand, shares the same features other than allowing only specific individuals or entities to join the network. The private blockchain is selective in who is allowed to join, giving more power to the owner. This is implemented mostly in organizations that want to maintain an aspect of centralization. Rogers made a great point in addressing personal gain stating "...adopting an innovation is not necessarily a passive role of just implementing a standard template of the new idea. Many adopters want to participate actively in customizing an innovation to fit their unique situation" [19].Here, power to the owner through selective authority is managed. Lastly, permission-based, also known as consortium blockchains, combine both public and private accessibility. They are tuned more to the liking of the authorities in charge [13]. The difference between private and consortium

blockchains is very limited in nature and mostly depends on whether there is a group in charge or exclusively one organization that is allowed to override the network.

1.3 Structuring of Thesis

The structuring of the thesis is as follows: introduction and literature review have been completed, this is now followed by sections on data collection and interview analysis metrics. The subsequent sections delve into the results of my analysis, including typical responses to the questionnaire and interesting comments. The document also addresses future discussions, open questions, and ethical considerations. Wrapping up with the final conclusion. Throughout the use of figures and tables further enhance the clarity and accessibility of the content.

Chapter 2

Data Collection & Interview Analysis Metrics

Within this chapter, I will write how the data was collected to come to a sound analysis and what steps were done and why it was chosen to be done in the manner that it was. I conclude the chapter by explaining how the data was pre-processed and the metrics applied.

2.1 Overview of Structure

Initially I wondered if sufficient insight would be given to me if I were to create my own blockchain environment. The realization came quickly after, that I did not have the sound skill-set nor the time to test the network with others. This then transitioned my thought process to speaking to the individuals who are proficient and work within the Web3 field and the individuals who are actively involved within the community and face the complex exogenous variables that are present solely within industry. This led me to the notion of conducting podcast-styled interview investigations. How else could I see what was happening in multiple fields / domains first-hand? Now understanding my premise; I had to create a

dialogue that would spark these needed conversations and solutions. Many others have done what I am attempting now in regards to questioning the viability of different premature technologies during the early adoption stage. To reiterate, this piece looks from the lend of the Diffusion of Innovations theory. The outline of interviews were manipulated from the Technology Acceptance Theory Model to fully structuring my guiding questionnaire. This process was developed before any conversation. This gave the research a systematic design to carry-out the analysis in an efficient manner. The set-up explanation will take you through the step-by-step process in which I collected my data for further use and extrapolation.

2.2 Set-up

The sample questionnaire that I used is one developed from the Technology Acceptance Model theoretical framework where questions are broken up into two categories: Perceived Usefulness (PU) and Perceived Ease of Use (PEU). Multiple different theories were investigated, but the Technology Acceptance Model was the one that showed the most promise in question creation. Below I have listed the questions that correspond to each category. The "Perceived Usefulness" of this technology in a particular individual's life is dependent on their industry. This questions if the individual deems the technology to be useful in adopting, because it would prove beneficial to them. The "Perceived Ease of Use" corresponds to an individual's perspective of the difficulty in learning and being proficient in this technology. Even if a technology is seen to be beyond useful; if the journey to learn the technology or effort it takes is a high barrier: adoption is highly unlikely [7]. On the next page, I provide the list of questions I have used with their corresponding category (i.e., PU and PEU) [7].

	Perceived Usefulness
1	Can you provide examples of how blockchain has added value to your work / business operations?
2	Do you think blockchain technology is essential to your industry, or is it more of a nice-to-have?
3	How would you rate the overall usefulness of blockchain technology in your work?
	Perceived Ease of Use
1	Have you encountered any difficulties / challenges when using blockchain?
1.1	If so, what were they?
2	Would you say that blockchain technology is user-friendly?
3	Are there any specific aspects of blockchain technology that you find difficult to use / administer?

Table 2.1: Questionnaire

Again the purpose of the questionnaire is to guide more than dictate the conversation flow. This structure brings a systematic way of investigating. Answers to initial questions or topics brought-up organically at times automatically answered upcoming ones. When this happened it seemed obviously redundant to ask again. For example, when asked the first question within the "Perceived Ease of Use" section, "Have you encountered any difficulties / challenges when using blockchain?". A respondent would make the claim that blockchain is not user-friendly. When this would be made explicit, then the following question, "Would you say that blockchain technology is user-friendly?" was not asked. Instead this gave me the opportunity to spend more time to investigate and listen to the things they were passionate in bringing up and discussing. Thus signaling / highlighting to me subject importance and

prioritization.

How scheduling went about was constrained by the limited time-frame given, starting from 24 March 2023 for approximately fourteen weeks until 12 June 2023. I created a Calendly booking page where I blocked-off forty-five minute meeting slots that were connected to Outlook and Microsoft Teams. This forty-five minute section was applied to be used as a buffer, since the sessions were planned for solely thirty minute chunks. This led to greater ease in managing the project. Now that I had my communication channel and resources put together, it was time to get the knowledgeable individual's contribution.

Interviews were conducted on industry experts on blockchain technology. These individuals are ones that either focus their career in working within Web3 (e.g., blockchain developer), work with the technology firsthand by delivering it as a service / product (e.g, blockchain consultant) or indirectly works with blockchain (e.g, Crypto Analyst).

Primarily the platform used to select my population sample was by networking via LinkedIn. LinkedIn is a social platform geared towards working professionals and businesses for business networking, marketing and job postings. Other than that a handful of others were contacted by referrals from class peers and mentors; and from research from related works and media.

As mentioned earlier: interviewees were collected by cold messaging via LinkedIn. Potential interviewees fell into three categories when responding: solely a 'connection' was made on LinkedIn, a follow-up agreement without a concrete scheduled meeting or the individuals who followed-up and committed to at least a thirty-minute styled podcast interview. The typical template sent in these cold emails either had something specific to that person's background (e.g., saying 'hello' or 'thanks' in their native language) or the default template. The default template is as follows:

Hi [Blockchain Industry Expert]:

I'm Gabriela Adams, a University of Georgia MS in AI student. I am highly interested in your expertise in blockchain. Would you be interested in a 30m podcast interview for my thesis on industry adoption of blockchain? I believe your expertise would be invaluable!
Thanks!

After sending this introduction in the LinkedIn connection feature of adding a note with a requisition to connect, if there was a follow-up I would explain more of the situation / scenario. Here is a default explanation I would give that helps capture the purpose and goal of my research:

Hi [Blockchain Industry Expert],

This is Gabriela Adams. We spoke via LinkedIn. I am a graduate student at the University of Georgia pursuing a Masters in AI. Last semester I took a FinTech course and was assigned a project in which I worked with Truist, a US bank where we researched how blockchain and digital identity could be used within finance. After being introduced to blockchain technology, it was something I knew I wanted to continue learning.

Some context as to why I am doing what I am doing:
I am writing my master's thesis on industry adoption of blockchain & AI. I am interested in this topic because within academia it seems like a "no-brainer" to utilize this technology. I am curious how blockchain has impacted business operations and what issues / benefits have arisen since deployment.

To kill two birds with one stone, I am conducting 30 minute interviews in podcast form (which will be done via Microsoft Teams).

Unfortunately I do not have anything published. I did my first interview this March 2023. If you do not feel comfortable with this set-up, I can solely use the information as reflection and guidance in my thesis writing. Also a quick note: I wouldn't post anything until you had listened to the episode and approved!

Feel free to pick a date / time that works well through this link:
https://calendly.com/adamsgabc/blockchain-podcast-interview

I have also attached a sample questionnaire that I use to guide the discussions. Please let me know if there is anything else I can answer.

Thank you for your time and energy,
Gabriela Adams

Something interesting to note is that even with my scheduling and structure, there were some anomalies in data collection. Majority of the interviews were recorded for publishing, but not all were as the message above depicts. Some individuals were happy to solely have their perspective be as help within this thesis rather than having their voices publicized. Not only that, but the communication channel in conducting the interviews varied, even though the majority was done via Teams. There was a minority of 22% done by either written, phone call or Zoom rather than the typical means of communication which was video conferencing off of Microsoft Teams. An even fewer number were done on the mediums provided by the interviewee's own end, majority being the mediums other than Teams. Meaning I would book an appointment off of their scheduling assistant. These interviews were conducted and

collected from 24 March 2023 for approximately fourteen weeks, 12 June 2023. A total of thirty-one interviews were conducted due to this method.

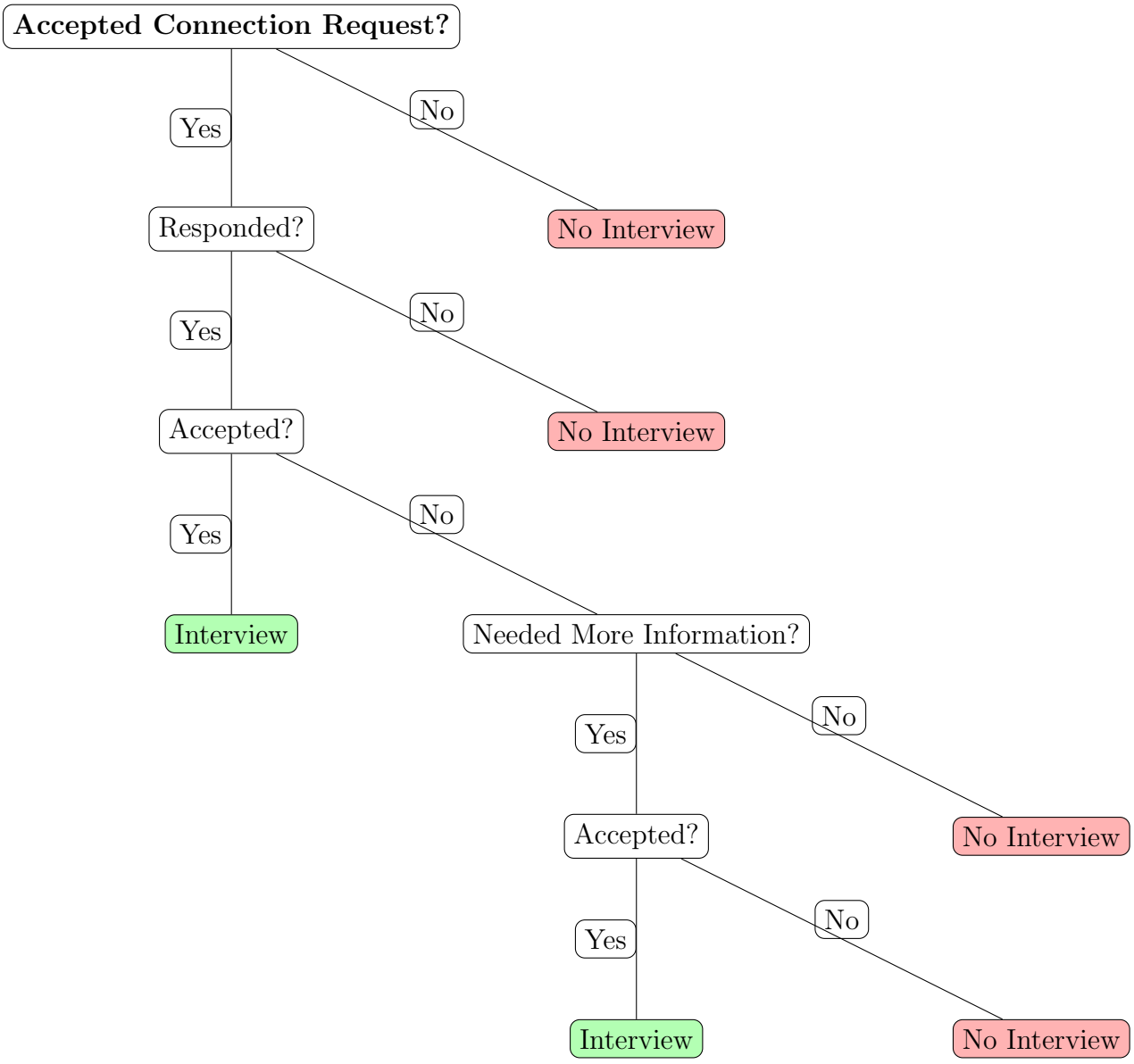

Figure 2.1: Interview Decision Tree

Figure 2.1 depicts a decision tree of what the process looked like when connecting to experts via LinkedIn. The final decisions are filled in with green for, "Interview" and red for, "No Interview". The LinkedIn message is first sent to the individuals. Either they

connect or do not. If they do not, that results in an immediate "No Interview" terminal node. On the other hand, when a connection was made there was then the question if the individual responded to the message. If they did not, that gave the same result as the other terminal node as, "No Interview". If the individual accepted the connection request and responded, then it was then determined by if they accepted the proposition immediately. If done so, then the leaf node, "Interview" is automatically resulted. If it was not immediately accepted, then there was the decision that they had accepted the connection, appreciated the request, but decided to not partake for various factors. This resulted in a, "No Interview". But there were a handful of candidates that needed additional information to see if they were willing to participate. After this additional information, the extended message I have written previously, was sent. This more information node also included answering the questions the individuals had such as sending a copy of the questionnaire for preparation. Then the last option to agree or decline the offer presents itself again. Similar to the previous theoretical exampled, the "No" resulted in, "No Interview" and, "Yes" to having an, "Interview".

I have created a list of generalized job titles of who I have interviewed and their respective industry. I have not added names nor have I written their exact position within their respective companies to keep anonymity within this writing. I understand the podcast I have conducted was done on the majority of individuals that wanted publishing of their names; so I have included only the ones that have agreed so on that platform itself to follow a consistent pattern in this work. None of the opinions are reflections of the company these individuals work at but rather their own opinion from their experiences and knowledgeable backgrounds of the technology itself. A special note worth mentioning is how the industry title was chosen. When searching the company via LinkedIn, there is section that the company decides out of a predefined set of choices of industry titles that the company chooses most encompasses their work. I have used this as the feature described in Table 3.2 and Table 3.3. Below are the positions and industries these individuals currently work in.

#	**Position**	**Industry**
1	Analyst	Self-employed
2	Analyst	Software Development
3	Analyst and Investor	Investment Management
4	Analyst and Researcher	IT Services and IT Consulting
5	CEO and Co-Founder	Technology, Information and Internet
6	CEO and President	Financial Services
7	COO Founder	Technology, Information and Internet
8	CTO	Hospitals and Health Care
9	CxO	Business Consulting and Services
10	Director of Services	Software Development
11	Director of Strategy and Advocacy	Blockchain Services
12	Freelancer	Self-employed
13	Founder	Blockchain Services
14	Head of Acceleration	Venture Capital and Private Equity Principals
15	Head of Developer Relations	Technology, Information and Internet
16	Incentive Architect	Blockchain Services
17	Marketing Director	Blockchain Services
18	Member	Information Technology and Services
19	President	Blockchain Services
20	Project Manager	Information Technology and Services

Table 2.2: Anonymized Interviewee Profiles

#	**Position**	**Industry**
21	Project Manager	Software Development
22	Research Scientist	Software Development
23	Senior Consultant	Business Consulting and Services
24	Senior Consultant	Business Consulting and Services
25	Software Developer	Software Development
26	Software Engineer	IT Services and IT Consulting
27	Software Engineer	Software Development
28	Solutions Consultant	Software Development
29	Transformation Strategist	Software Development
30	Technical Lead	Oil and Gas
31	Vice President	Financial Services

Table 2.3: Continuation of Anonymized Interviewee Profiles

I have grouped the industries by color to give a more generalized summary. For example, the pink shading represents a technical-based industry without a specified blockchain niche. Within this table it encompasses, "Information Technology and Services", "IT Services and IT Consulting", "Software Development" and "Technology, information and Internet". "Blockchain Services", "Hospitals and Health Care", "Oil and Gas" and "Self-employed" were unique attributes, so I had them colored separately: yellow, teal, orange and magenta respectively. While the rest were grouped in either green to represent anything to deal with money management or red for a generalized business focused sector. At 58% approximately half of the candidates were related to a generalized technical industry. Approximately 16% of the interviewees companies focused purely on blockchain as a service. Representing 74% so far, with the remaining 26% made up majority by financial services at a bit over 12%.

Count	Industry
8	Software Development
5	Blockchain Services
3	Business Consulting and Services
3	Technology, Information and Internet
2	Financial Services
2	Information Technology and Services
2	IT Services and IT Consulting
2	Self-employed
1	Investment Management
1	Hospitals and Health Care
1	Oil and Gas
1	Venture Capital and Private Equity Principals

Table 2.4: Industry Count

#	**Channel**
1	Teams
2	Text
3	Teams
4	Zoom
5	Zoom
6	Call
7	Teams
8	Teams
9	Teams
10	Teams
11	Teams
12	Teams
13	Teams
14	Teams
15	Teams
16	Teams
17	Teamss
18	Zoom
19	Teams
20	Teams

Table 2.5: Communication Channels

#	**Channel**
21	Teams
22	Zoom
23	Teams
24	Teams
25	Teams
26	Teams
27	Teams
28	Teams
29	Teams
30	Teams
31	Zoom

Table 2.6: Continuation of Communication Channels

Count	Country
17	United States
2	United Arab Emirates
2	Netherlands
1	Argentina
1	Cyprus
1	Indonesia
1	Kazakhstan
1	Pakistan
1	New Zealand
1	Qatar
1	Sweden
1	Switzerland
1	United Kingdom

Table 2.7: Interviewee's Country Count

Approximately half at 54% of the individuals interviewed reside in the United States.

2.3 Post-processing Automating / Techniques for Transcripts

Pre-processing the data looked differently depending on what medium I took to record the conversation. The reasoning behind why I chose Microsoft Teams to host my conversations was due to the ease in having an immediate transcribed web video text tracks (VTT) file available for me to manipulate with natural language processing (NLP) later on [5]. Zoom, written-responses and the phone call was different, because either I had to remember the

conversation immediately after by writing down my synopsis or I had to manually do my own transcription if I was fortunate to have the meeting recorded. Personal understanding of body language and diction throughout the video-interview was done based-off personal interpretation of tone and topics covered. Outside of that, I performed NLP to gain statistics to attempt to interpret the open-ended the questions are and the nature of a semi-structured conversation. Then to further provide clarity on my analysis, I went through the transcriptions to find common themes the interviewees had covered.

Chapter 3

Analysis Results on Interviews

Blockchain technology faces several challenges and issues that impact its implementation and use in various industries. Some of these challenges include: low adoption rate, poor interface, confusing governance, and little scalability.

Blockchain technology is valuable but this analysis acknowledges the need for continued development, education, and regulatory considerations to maximize its benefits and minimize its drawbacks. In the next section, I will go through each of the questions that make up the questionnaire and give a generalized response of the main points made by the respondents and to also contribute any interesting outlier responses.

A quick note I want to make is that I will be adding occasional parenthesis to share a little more information by providing certain Interviewee numbers. That is if a statement is made, and it isn't to revealing to add the Interviewee number, I will do so. For example, if (13) is denoted, that represents it was an idea held by Interviewee 13, but not limited to solely Interviewee 13.

3.1 Typical Responses to Questionnaire

Can you provide examples of how blockchain has added value to your work / business operations?

There were two perspectives on the answers given for this situation. Firstly, some respondents were able to provide immediate examples of how blockchain technology has positively transformed their business. On the other hand, respondents in developer roles within blockchain-focused companies such as Interviewee 25 and Interviewee 26, or individuals working as Crypto Analysts were unable to gauge the extent of change or impact on their company or profession, as they lacked a point of comparison. It is worth noting that all the responses received were overwhelmingly positive.

An individual, who works directly on the automation aspect of the blockchain spoke how the value add to work is something that is still philosophical, stating that "a lot of the use cases are still unknown" (5). A lot of the interviewees such as Interviewee 1, who oversee business operations state how blockchain technology has proven to be a game-changer in multiple ways. One remarkable example involves streamlining supply chains, ensuring product authenticity, and enhancing customer trust.

This is one of the scenarios a respondent gave: imagine a company imports and sells products from Italy. The challenge lies in verifying the authenticity of these goods and combating the proliferation of counterfeit products that damage the reputation of genuine Italian-made items. To address this issue, a non-profit organization dedicated to promoting "Made in Italy" goods has leveraged blockchain technology. Through a bottom-up approach, this organization tags and validates products on a blockchain throughout the entire supply chain. Each step of production, from sourcing raw materials to manufacturing and distribution, is

recorded and verified on the blockchain. This process provides an immutable and transparent record of a product's journey, ensuring its authenticity. By utilizing blockchain as a zero-trust mechanism, customers can confidently verify the origins and quality of their purchased products. This not only fosters customer satisfaction but also combats unscrupulous sellers who falsely claim their products as "Made in Italy" to exploit the reputation of authentic goods. The blockchain-based verification process protects the interests of both consumers and companies within the supply chain. Drawing a parallel with the Food and Drug Administration's (FDA) stamp of approval in the United States, this country-wide blockchain verification process acts as an additional measure to enhance work and business operations. It adds an extra layer of assurance for companies participating in the supply chain, fostering trust among stakeholders and facilitating streamlined operations (13).

Do you think blockchain technology is essential to your industry, or is it more of a nice-to-have?

This is truly dependent on industry. For the people working in Decentralized Finance (DeFi), blockchain is the cornerstone of all the operations they work with. The entire identity that blockchain provides for this sector is what brings others in. If the company is focused on anything web3, then yes the technology is also essential. But for all the others mentioned, there wasn't a component to it that deems that blockchain must be used. Blockchain being used is something that provides ease and benefits, but it isn't necessary since we can see most of our programs being run in current time without the need of blockchain. An example of this are the blockchain consultants, as it is stated in their title, they are also ones that believe it is an integral part of their industry. Even though that is their forte, consultants and analyst who provide free-lance work try to solve the overall issues their clients have. These

professionals make sure to provide a solution that is the most relevant to the case they are on. This means if it isn't blockchain, it isn't blockchain. This causes their viewpoint of blockchain technology to be more of a "nice-to-have". A commonly used tool in their tool belt, rather than forcing others to adopt it if it isn't truly necessary or beneficial (12, 23, 24).

One interviewee who works for a major oil and gas company believes blockchain is the solution they are looking for in preventing accusations of "greenwashing". Greenwashing is an action that occurs when an individual, corporation or organization is misleading others by exaggerating or being deceptive about their sustainability practices to enhance their reputation. They deemed the technology as an "essential" way of proving their carbon emissions and validate the actions taken by the organization. Deeming blockchain as an incremental part for upholding the industry's policies, but not necessarily essential for the industry to continue running (30).

Another respondent who serves as a consultant hinted at the same topic by mentioning how this system will be what major companies and non-profits will use to be able to disclose the sources of all their goods and services; and to be able to disclose how they are using their money. They state how we do not necessarily need to know every actor in the procedure, we rely on the auditing done (24).
Currently this is done by deferring trust to centralized institutions which is why blockchain will be more pervasive in the future that instead of deferring trust to an institution, which is a lot easier to be corrupt as an institution than as a contract created and executed by code. This switch of deferring trust to code does make people with knowledge in reading code be then trusted to say "yes" or "no" to which we are still relying on a third-party indirectly, but now to one who doesn't have control over the assets. This being the new democratic way of deferring trust (6).

Other individuals related to the marketing field say that the technology is not essential for the entirety of the industry, but if one is wanting to be at an advantage or ahead in the digital marketing realm, it is essential to learn the basics of blockchain technology since we are making our ways towards a world where we will interact in the virtual-reality, Metaverse. It is only a matter of time before Blockchain is in every marketing agenda (17).

This poses the next thought, will blockchain technology eventually become an essential for these individuals' industries even though for some it isn't currently regarded that way? Majority of the individuals in this space agreed yes and that this was the main reason they had chosen to work with this technology. The only hesitation and hindrance for the respondents that agreed is of the evolution and adoption would be regulations set in place by countries and governing powers forcing a stop to its usage, such as Qatar. Interviewee 28 expanded on this by commenting on how blockchain adoption is still in the early stages in Qatar. However, there are conferences and events happening to promote innovation in this area. Dubai, on the other hand, is leading the way in blockchain adoption in the Middle East, with dedicated funds and openness to decentralized finance.

Although Qatar is more traditional and relies on comfortable technologies, there are some projects like IBM Food Trust that are exploring blockchain applications in the country. Blockchain has the potential to provide qualified data and transparency, which is crucial for applications like ESG ratings and supply chain traceability.

Furthermore, blockchain can make processes more efficient and cost-effective, such as in the construction industry for notarization of contracts and receipts. Defense industries are also exploring blockchain technology, but there are concerns about its potential misuse.

Overall, blockchain is seen as a promising technology with many potential applications. However, there is still a lot of work to be done in terms of adoption and integration into

existing systems in Qatar.

Currently at this time, there are a number of countries that aren't allowing for cryptocurrencies and others embracing it and letting their country accept certain cryptocurrencies as a form of payment. For instance, two years ago El Salvador recently became the first country to adopt Bitcoin as legal tender [1].

Again only a couple were hesitant on the future, but had strong hopes for it to go in the way they imagine it is pushing towards. Their main worry was of the changing and restricting regulations that are now being or potentially be put in place. There was an analyst that had mentioned if quantum computing is actualized, there would be no more Blockchain. Another that followed up with this comment, stated that "if quantum computing is successful enough that it can decrypt our current best encryption method, then Blockchain suddenly goes from being this amazing technology to an extremely dangerous point of lack of privacy, because now anybody who has access to a computer powerful enough would be able to decrypt the data. Now suddenly you lose all your privacy and then at that point, are you know handing over more power to who has access to these supercomputers? Are they the same that we are trying to remove power from that centralized authority" (1).

With that thought in mind, we discussed that if it got to that point, there would be a radical change in everything technological. The common outlook for all were positive and moving towards a life where blockchain will become inevitable or will be seen as an alternative service that is offered. One respondent did say this question depended on what side one took. The emergence of the internet brought both positives and negative to society, good and nefarious actors. Technological advances have taken place with the birth of the internet, but one can go to the other extreme and share that with the help of the internet how much was done concerning bioweapons (12).

With this in mind, there was a range of different timelines of when blockchain will became massively adopted, some ranging from five years from now to twenty to many generations to come.

A comment worth mentioning is that there has been an over-hype of the blockchain Web3 term. This has caused consequences since there are current phony companies and people who are solely advising to use blockchain services as a way of promoting themselves and not being genuine in advising others. Needless to say, in any industry and technology there will be individuals and organizations that push certain products and services without putting the customer's needs first to hit a certain quota.

How would you rate the overall usefulness of blockchain technology in your work?

This question was very similar to the ones before it. Most individuals did not give me a number scale, but all said, very useful to essential. All the respondents have their entire profession revolving around blockchain. This element is self-explanatory why they rate it so highly and have dedicated their time and energy into this technology. This ended up seeming like a filler question and just an elongation of the one before it, "Do you think blockchain technology is essential to your industry, or is it more of a nice-to-have?".

Blockchain technology to some companies have acted as an extra layer of security. By having more than one server in-charge of operations protects organizations if one does go down. This not allowing the single server to cause disruption to the others or the entire network. This is in comparison to a centralized network which is susceptible to hackers because it is extremely dependent on one point of failure. So by having blockchain, it created multiple points and multiple people running the network thus creating a stronger protection

mechanism against hackers (28).

Interviewee 4 shared that it is extremely useful as it is cleaner data to work with, since it is essential "open-source". Comparing it to the traditional financial investigations, when a wire is sent out, you have to contact the institution and then have the information shared (taking so much time). But when it comes to blockchain investigations it is significantly easier, because you see all that is going on and you are able to trace and attribute certain transactions to their corresponding wallets.

Have you encountered any difficulties / challenges when using blockchain? If so, what were they?

Since this question is very open-ended, I got a mix of answers. Some explaining about the difficulties with the technology itself and others in the sense of how it has impacted their work / business operations. The main answer was how difficult it was to initially educate themselves on the technology (27). Some individuals noting the difficulty in learning the technology in first adopting it also mention that there are days that they still have to practice concepts all over again and remind themselves on how to perform certain operations. This is all due to the lack of proper documentation and material on the web. The technology itself is not intuitive in nature and there isn't much information documented to help when trying to search for solutions. The learning is more of a trial-and-error experience. Thus taking a lot of time and brings a big obstacle for developers, since the learning curve is a bigger one than what the standard DevOps practice is (1).

An analyst, Interviewee 2, works primarily on the programmability, where they develop languages that enable blockchain developers to develop more blockchain based apps with greater ease. They claim that the main difficulty is the transition of developing an app on one's local computer to now creating an application on a blockchain. The issue is presented

because now there are many different factors. For example, when working with blockchain, everything is now public and completely decentralized. This means anyone has access to go over what one has done with the code, so there is little to hide. This is a difference because in most mobile and desktop apps this is fairly common. Say that hiding is done through the use of advanced cryptography to hide certain information, this only leads to a slowdown in the transaction rate of the blockchain.

This present the next issue developers currently face when transitioning to blockchain versus their desktop / mobile applications. Runtime is extremely slow and inconsistent. Since blockchain is early there is much slower efficiency compared to how one's local computer. The foundational differences is what presents a barrier to the developers. Making it known that it is a new process that needs to be learned and little that can be translated over.

The people who they try to sell their products or services to their customer market are very few in numbers in comparison to the population of customer in other industries (6, 7, 15).

Since the technology is premature, investors and users are not as keen to attempt something that does not have consistency. This premature technology does not yet suit "compatibility" with investors, as Rogers would phrase it. This again comes from the poor representation of what blockchain is (another newness downside) thus hindering the potentially transformational inventions (7).

The prematurity of the technology and the decentralized nature makes the resources very limited. To the problems being exposed, there hasn't been enough time to find common solutions to what are the most effective and secure ways to administer certain tasks. For

example, when an analyst is helping investors mitigate risk, they still face the risk that they are not able to sell at a certain time due to the high-traffic preventing them to do so. Analysts also can do nothing when a blockchain stops working altogether without reason, and their client's money that was invested into it is no longer able to be accessed. This becomes and issue and the clients wonder who they can contact, but since the blockchain network is created to have no central authority, there is no one to reach out to (4).

Would you say that blockchain technology is user-friendly?

No, not at all. That is the black-and-white answer. I have experience in this first hand.

Looking on the positive side, there are many people focusing on this direct issue and making significant improvements in creating user-friendly platforms at such a fast pace. This interface of how to interact with the blockchain is represented consistently with how the internet first came about (19, 20). When one searches online for a company, it is very skeptical if there is no affiliated website for them, deeming them to be less reputable than the ones that do.

The user experience of the technology is one of the key elements that hinder adoption to the masses and for adoption of the potential developers. There have been notes and mentions of changes that need to be made. Again to mention that there are a subset of individuals dedicated in creating interfaces that allow to have the users experience become more effortless (2, 10).

Another respondent spoke on how they survey students to see what processes can be improved to make the user experience better. Most claim that there is no centralized way of learning the technology, which is continued to be highlighted to be one of the biggest

challenges blockchain must overcome. An interesting factor in the surveys collected is how respondents expressed that learning the language itself was not the part that came hard, it was the understanding of how to interact with blockchain. Syntactically there was no problem, but in deeper understanding in how lower level computing operated, that is where the underlying issue pointed towards (4).

Are there any specific aspects of blockchain technology that you find difficult to use / administer?

Interviewee 2 answered the following question in a succinct way that encapsulated the majority consensus, "For my case it's not something difficult or not, I would say sometimes to remember the role of every type of nodes, what it can do what it cannot do, does it have permissions to a specific type of data or not". Either that or there were only a few humble souls that were willing to admit how they had spent a lot of time learning the characteristics of blockchain and the continuous stream of news on the matter, that they were always researching for reminders or insight, as what any software developer would.

	Perceived Usefulness		
	1	**2**	**3**
Decentralization	[-] Unable to gauge, because of no point of comparison (25, 26) **I**	[+] New democratic way of deferring trust (6) **C/T**, [+] As an advantage in the digital marketing realm, it is essential (17) **C**	
Security	[+] Combats unscrupulous sellers, and adds an extra layer of assurance (13) **I**	[-] Qatar is restricting blockchain projects due to the lack of security offered (28) **I/C/S**	[+] An extra layer of security by having more than one server in-charge of operation (28) **I**
Transparency	[+] Streamlining supply chains, ensuring product authenticity, enhancing customer trust (1) **I/C/S**	[+] An "essential" way of validating carbon emissions, but not an industry "necessity" (30) **I**	[+] Cleaner data to work with to trace and attribute certain transactions to their corresponding wallets (4) **I**
Immutability		[+] State how we do not necessarily need to know every actor in the procedure, we rely on the auditing done (24) **C**, [-] Defense industries are also exploring have concerns about potential misuse (28) **S**, [-] Quantum computing would reveal everything (1) **I/T**	
Trustless Transaction	[+] Fosters customer satisfaction, trust among stakeholders (13) **C/S**, [+] Value add is still philosophical, "a lot of use cases are still unknown" (5) **I/T**	[+] Deferring to code execution rather than institutions that have the potential of corruption (6) **S**	

Figure 3.1: Key Questionnaire Categorization of Perceived Usefulness

	Perceived Ease of Use		
	1	**2**	**3**
Decentralization	[-] Difficult transition of operating off a node rather than local computer (2) **I**, [-] Few in numbers in comparison to the population of customer in centralized industries (6, 7, 15) **T/S**, [-] Network is created to have no central authority, there is no one to reach out to (4) **C**	[-] Key element that hinder adoption to the masses and for adoption of the potential developers is the lack of knowledge of decentralized entities (2, 10) **I/C/T**, [-] Poor user experience (4) **T**, [+] Fast pace creation of user-friendly platforms at such a fast pace (19, 20) **I/T**	[+] Decentralization is only as beneficial as you remember how it works individually (2) **I/T/S**
Security			
Transparency	[-] If hiding is done through the use of advanced cryptography, this slows down transaction rate (2) **T**		
Immutability	[-] Trial-and-error DevOps due to unalterable experience (1, 27) **T**		
Trustless Transaction			

Figure 3.2: Key Questionnaire Categorization of Perceived Ease of Use

The above table depicts the categorization of the responses given and used within the analysis. This helps integrate the knowledge learnt from the interviews in the context of DOI. The '+' or '-' symbols represent a positive or negative comment respectively. By each point there is a number within parentheses used to denote the specific interviewee the phrase is referring to; and the letters I, C, T or S are used to tie it back to the four elements that make up the Diffusion of Innovations. The theory which posits that there is a discernible pattern in how innovations are adopted and disseminated, which is marked by distinct groups of adopters. To reiterate the definition from before, it "is the process by which an innovation

(I) is communicated through certain channels (C) over time (T) among the members of a social system (S)" [19].

Let's go through a couple examples to understand how to read the above figures. By observation, the feature of decentralization is overall positive for the three questions regarding perceived usefulness, but overall negative for perceived ease of use. Then it is noticed that most of the DOI elements associated to the decentralization statements are "T", regarding time. Last example, in Figure 3.2, every key theme regarding question one was negative. This being intuitive, due to the nature of the question asked, "Have you encountered any difficulties / challenges when using blockchain? If so, what were they?" explaining the plethora of negative responses.

3.2 Interesting Comments

Interesting conversations that are notable and needed to be mentioned are the following:

People mentioned the implications of using blockchain to make the internet more secure, in other words privatizing identity. With what the big tech companies are doing now in mining our personal information, this is a way for us to have control over what information we want to protect from centralized sources. Interviewee 24 gave a use-case example of personal data ownership. Think on the times you've visited a website, it is common to have your cookies collected where the site will track your information, learn about you and your activity to personalize your experience gearing it towards your preference. But it also harvests that information, packages it up with other people's information and sells it for a profit. Now imagine "in a web3 system where instead of the website having all that ownership and power, you bring your data to the website and you leave with it". Now the interface you interact with will customize as soon as you come back to the site and allow for it. The

cookies rather than being harvested by the website is now saved onto your IP address as information for the site to read if you decide to return to it. This being a difference in who is storing your personal data and the people owning their own data.

Chapter 4

Future Discussion / Open Questions

4.1 Current Implications of Blockchain

Blockchain technology has already demonstrated its revolutionary potential in certain sectors. One example that we have already come across is its application in verifying and ensuring the authenticity of products. The Italian non-profit organization that is utilizing blockchain to validate and track "Made in Italy" goods throughout the supply chain is one of the most prominent examples of blockchain working now. By tagging and validating products on the blockchain, they can provide customers with assurance regarding the authenticity of the products and combat counterfeit items. This not only supports the Italian economy but also enhances customer satisfaction by delivering high-quality goods. This is an amazing feat, because it is the solution to a growing problem that needed to be solved.

4.2 Deficiencies in Blockchain Technology

From the collective of responses given, I have gathered that what isn't done now will affect the future in a detrimental way when we as a society are forced to look for new ways of

adapting. Right now, there are a lot of things done that aren't as effective as they could be, but are still used because they has been the done so for so long. This reminds me of how Near Field Communication (NFC) took a while to gain traction in the U.S. in comparison to stores in Turkey. My understanding here is, it took a pandemic to bring about the fast adoption of contactless payments to our society, because there was a dire need. COVID-19 served as a catalyst of the inevitable. NFC, mobile payments and any other efforts in providing a safe and alternative way of living life was presented and highly adopted. These technologies and applications were already going to be adopted, but it all was dependent on the time and culture of the users. "Users' perceptions will be positively influenced when technology's specific characteristics can benefit a particular situation" [27]. The same is soon to happen with the adoption of blockchain technology in different sectors. Currently, our typical methods are sufficient. Companies do not want to go out on a limb to take on a technology that they don't see will be any difference to the one they have in place, until they face a problem where it is inevitable to do so. In this point in time, many major companies are solely having a blockchain branch for research purposes and aren't ready to merge the conservative practises with an innovative technology.

Some issues are ones already presented in the answers: risk of security in certain scenarios, the limited amount of resources for education and misrepresentation the media portrays it.

The main question needed to be addressed is: Is this technology worth improving? If so, how? Simple answer yes and this is through the usage of artificial intelligence. Especially in this year where we see the rise of AI being used within various sectors and the demand has been exponentially sky-rocketing. We understand that there is power here that, if harnessed, can create ease in the issues we already face and will face in the future. What we see in the analysis is that the majority of the issues are fixable.

The dilemma is the time we are in: the developmental stages. One cannot see what the future holds and only rely on the potential the technology is giving now. This is a

big decision in recommending the continuation of blockchain or not, since lack of adoption now and in the future (no matter how great the technology is), will simply be that: lack of adoption and no blockchain usage.

Adoption levels need to rise. We are facing issues of misinformation, lack of resources for developers and users in terms of implementation and user experience. If we can fix these pain-points now, we can create a implementation of the technology that corresponds to what academia has continuously theorized and researched.

For example, companies can utilize natural language processing techniques for their client and employee's user experience. Natural language process is a subset of AI focused on the linguistical approach of human and computer-interaction. Companies can utilize AI with the creation of chatbots. This solution could be used to guide user experience and answer the most common questions when it comes to using a blockchain. As we had discussed in the analysis, when an investment analyst is trying to help their clients access their crypto wallets, they can immediately go to the chatbot and ask the questions there before speaking to an employee. With this, it can help in providing a better experience for the user and give the time back to the analyst to focus on other things, thus saving the individuals and the organization's time and money. On the employee's side of things, this can also help guide the creation of blockchain, this process could streamline developmental phases, since it can act as an assistant when creating and debugging the programs.

Along with this, AI can provide security. Imagine the issue we spoke about earlier when in came to the front-running bots that manipulate the system. As we see today where there are AI models that detect fraudulent activities within the backing sphere, this can be easily translated the blockchain network. The AI that is being performed in centralized finance should be experimented with to perform the tasks within decentralized finance.

This same concept can help with the creation of hash-codes that are harder to decrypt [2]. Utilizing AI in this way, companies can protect their data more efficiently in reliance to

AI [10] [4].

AI can take on practical matters and blockchain can be used to show how models have been trained since their transparent nature. This will be a great transition from the biased models that are being produced. Ethically, on how the models have been trained. Blockchain is what can decentralize these AI systems. Interviewee 7 stated "They can train from kind of decentralized datasets run on decentralized computers" and "write AI Dapps on the blockchain that can do these sort of decentralized transactions". It will be interesting to see how AI can process information stored on blockchains and how they will eventually interact.

4.3 Ethics Statement

Regarding all that was researched, it is necessary to mention that again, this insight is not a direct influence as to what organization works for, but the experience they have had in working with blockchain technologies.

4.4 Self Reflection

What I would recommend to others is to continue on seeing what is being done within industry and what is being done for the education of blockchain growth.

If I were to conduct this research again, there would be a few things I would have done differently. I would have asked less about what they deem the potential of blockchain is and go more into the nitty-gritty, such as in asking what they personally think AI can help solve their blockchain deficits or showing them an s-curve and asking the individuals to roughly point where they believe we are currently. I would also be intrigued to speak more to the individuals that do not have their industry revolving blockchain and ask how their colleagues

and company view them. Are they more optimistic than their peers of this technology? I am also curious to hear from the clients themselves and see if they notice any difference and why it is the case that they chose to work with blockchain technology rather than another database.

Conclusion

In conclusion, the study of innovation and its diffusion is vital in understanding the dynamics of societal acceptance and adoption of new ideas, practices, and technologies. The case study of the water-boiling campaign in Peru illustrates the importance of cultural awareness and client-oriented thinking in the success of an innovation. Everett Rogers' diffusion theory provided valuable framework for analyzing the adoption process, emphasizing factors such as relative advantage, compatibility, and interpersonal communication. The investigation of blockchain technology presents a contemporary example of innovation with the potential for widespread impact. Its unique features, such as decentralized verification and encryption, offer opportunities for secure and transparent transactions across various networks. However, blockchain's success in society hinges on factors like credibility, relative advantage, and compatibility with target audiences.

Furthermore, the role of opinion leaders and change agents cannot be understated in influencing the adoption of blockchain and similar technologies. Their technical competence, social accessibility, and adherence to societal norms play a significant role in shaping public perception and acceptance. Comprehensive exploration of blockchain technology was accomplished, aiming to shed light on its current state of adoption across industries. Through interviews with industry experts and a thorough analysis of the technology, we have gained valuable insights into its potential, benefits, and challenges.

Blockchain, defined as an immutable, decentralized, append-only database, presents itself

as a revolutionary innovation with its unique attributes of immutability, decentralization, and a zero-trust mechanism. These characteristics set it apart from traditional databases and offer a promising alternative for various applications. The advantages of blockchain adoption are evident, particularly in the finance sector, supply chain, and gaming industry. Its potential to transform these industries by providing higher security, transparency, and auditability is substantial. However, it is important to acknowledge the challenges and uncertainties associated with blockchain adoption. These include concerns about user-friendliness, interoperability, security risks, scalability, and cost implications. As the technology continues to evolve, we may see these challenges being addressed, leading to greater adoption and integration of blockchain solutions across different sectors. Additionally, the involvement of prestigious universities in blockchain research and education is an encouraging sign of its potential for widespread acceptance. In examining the complexities of blockchain, it is crucial to recognize the efforts made by developers and researchers to create a technology that is not only secure but also understandable to end-users. The concept of smart contracts and decentralized applications further expands the possibilities of blockchain beyond currency.

Overall, blockchain holds immense promise as a transformative technology with the potential to revolutionize various industries. However, its full adoption will depend on overcoming current challenges and uncertainties, and on continued research and development efforts. As the technology matures, we may witness a broader acceptance and integration of blockchain solutions, ultimately reshaping the way we conduct business and interact in the digital world. Throughout the study, detailed methodology employed in collecting and preparing the data for analysis was done. The decision to shift from creating a blockchain environment to conducting podcast-styled interviews with industry experts proved to be a strategic move, allowing for a deeper understanding of the complex exogenous variables present in the Web3 field. This shift was informed by the realization of practical constraints and the recognition of the need for insights from individuals actively engaged in the indus-

try. The structured questionnaire, based on the Technology Acceptance Model, provided a systematic framework for guiding the conversations. This approach allowed for flexibility in the discussion flow, ensuring that important topics were addressed organically. Through this process, it became evident that some questions were inherently addressed by the interviewees, eliminating the need for redundancy.

The scheduling process, constrained by a limited time-frame, was efficiently managed through the use of a Calendly booking page. This strategic allocation of time slots, coupled with the buffer period, contributed to the seamless execution of the project. With the communication channels and resources in place, the contributions of knowledgeable individuals were successfully obtained. The interviews conducted with industry experts provided invaluable insights into blockchain technology adoption and utilization. The selection of interviewees was primarily facilitated through networking on LinkedIn, a platform tailored for professionals across various industries. This method yielded a diverse range of perspectives, ensuring a comprehensive understanding of the subject matter. Despite some anomalies in data collection, including instances where interviews were not recorded for publishing, a total of thirty-one interviews were successfully conducted. The decision tree presented in Figure 2.1 illustrates the process of connecting with experts via LinkedIn, highlighting the adaptability of the approach. The anonymized interviewee profiles, categorized by industry, offer a clear snapshot of the diverse backgrounds and expertise of the participants. This diversity ensures a well-rounded perspective on the adoption and usability of blockchain technology across various domains.

Furthermore, the preprocessing of data varied depending on the recording medium used. The choice of Microsoft Teams facilitated immediate access to transcribed VTT files, enabling subsequent NLP analysis. For other mediums, additional steps were taken to ensure accurate interpretation of conversations.

All in all, blockchain technology presents immense potential for transforming various in-

dustries. However, it also faces significant challenges, including low adoption rates, interface complexity, governance issues, and scalability limitations. These hurdles underscore the need for ongoing development, education, and regulatory considerations to maximize the benefits and minimize drawbacks associated with blockchain. However, it is crucial to recognize the existing deficiencies in blockchain technology. The current state of adoption is influenced by factors like cultural norms, technological readiness, and the urgency of need, similar to the adoption curve experienced by technologies like NFC in the past. While blockchain holds significant promise, it is in its developmental stages, and adoption levels need to rise. To address these challenges, the integration of AI holds tremendous potential. By utilizing AI, companies can enhance user experiences, streamline development processes, and bolster security measures. Natural language processing and chatbots, for example, can significantly improve user interactions and assist with common queries related to blockchain usage. Moreover, AI can play a pivotal role in ensuring the security and integrity of blockchain networks, detecting fraudulent activities, and enhancing data protection through the creation of more robust hash codes. The combination of blockchain's transparency with decentralized AI systems opens up exciting possibilities for the future of technology.

It is essential for organizations to stay up to date in industry developments and prioritize education in the realm of blockchain technology. Future research in this area could delve deeper into the practical applications of AI in addressing specific blockchain deficits and involve perspectives from a wider range of stakeholders, including clients and industry peers. By continuing to explore the potential synergies between blockchain and AI, we can pave the way for a more efficient, secure, and user-friendly technological landscape. As the technology evolves, it is likely to play an increasingly integral role in shaping the future of business operations and digital interactions. The diffusion of this innovation is underway, with its strengths proving great potential to be a global success in the near future.

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