Aalto University
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IS THE INCLUSION OF A CRYPTOCURRENCY MINER IN ANTIVIRUS SOFTWARE A GOOD IDEA?

A case study on Gen Digital Incorporated

Master's Thesis
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Abstract of master's thesis

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Abstract

This thesis is using a qualitative research approach to answer the question, if the inclusion of an Ethereum crypto miner in Gen Digital Incorporated's antivirus solutions Norton360 and Avira Antivirus is a good idea. There is a lack of scientific research on how users change their view about a software company that include a cryptocurrency miner in their antivirus software. With energy consumption concerns rising and cryptocurrencies being at a two year low it is important to analyze the effect this business practice has on users. The results can be used by companies for decision making and users to understand the environmental impact of cryptocurrency mining. With semi-structured interviews of ten antivirus software users, data was collected about their views of antivirus software, cryptocurrencies, Gen Digital Incorporated and the environmental consequences of a cryptocurrency miner. The findings suggest that it is indeed a good idea, from a user and company perspective, even though we live in an energy crisis at the moment. The environmental consequences were not seen significant enough to raise consequences for Gen Digital Incorporated. A call for lawmakers is proposed to get companies to take responsibility for the emissions their software is causing. Also, limitations and future research are discussed.

Keywords cryptocurrency miner, antivirus software, Gen Digital Incorporated

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I want to acknowledge my spouse and soon to be wife Laura without whom I would have been undoubtedly not been able to tackle, in times of covid and loneliness, this enormous task.

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1 Introduction

Cryptocurrencies are at least since 2017’s spike of the value of Bitcoin, worldwide known (Higgins, 2017). Many governments (Comply Advantage, 2018) have already adopted their laws for the usage, taxation or in some cases bans of cryptocurrency banking. Even though the underlaying technology, blockchain, is already a few years old (Sherman, Javani, Zhang, & Golaszewski, 2019) no application including blockchain technology has really spread to consumers with little technical understanding. The most common application of blockchain technology is still cryptocurrency mining and trading (da Cunha, Soja, & Themistocleous, 2020).

The mining in particular has been under criticism for being environmentally damaging and producing unnecessary energy-waste (Näf, Keller, & Seiler, 2021). Many cryptocurrencies are still using a so-called proof of work mechanism which relies on validation by computing power. With more power outages occurring (Turak, 2021) the switch to a more environmentally friendly proof of stake mechanism is needed.

Gen Digital Incorporated is a software manufacturer known for their consumer software such as Avira Antivirus and Norton Security. In an announcement on the 2.6.2021 they confirmed a new feature of their antivirus solutions. Gen Digital Incorporated included an Ethereum cryptocurrency miner in two of their common antivirus solutions. (NortonLifeLock Inc., 2021) This inclusion changes the usually very tech-savvy process of setting up a cryptocurrency mining software to simply pressing one button. With a self-claimed userbase of around 500 million users (Gen Digital Inc., 2022) Gen Digital Incorporated granted, as the first software company, simple access to a proof of work based cryptocurrency mining software to a big userbase. With that possibility those users and the environment itself are experiencing its advantages and disadvantages.

Cryptocurrency mining is usually done on specific computer hardware to minimize energy consumption and to maximize profitability. The inclusion of cryptocurrency miners on non-optimized hardware could have a significant impact on the overall efficiency of the cryptocurrency (Huang, O'Neill, & Tabuchi, 2021). There is a lack of research how these aspects influence the users’ opinion and if they accept the inclusion of cryptocurrency miners in security software in general.

This thesis is going to explore the users' view about the inclusion of a cryptocurrency miner in antivirus software and contributing scientific research on whether it is seen as a good practice.

1.1 Previous research

Different Blockchain possibilities and cryptocurrencies have been researched quite extensively. For example, Pham, Adamopoulos, Tait (2019) have analyzed 37 recent studies and formed a conceptual framework towards a triple bottom line of blockchains in the supply chain environment. Medaglia and Damsgaard (2020) also researched the possibilities of blockchain and mapped different blockchain applications to the 17 United Nations Sustainable Development Goals. Overall blockchain applications and technological implementations are thoroughly discussed in academia.

Also, the challenges of blockchain applications have been researched. Chhina et al. (2019) did a systematic literature review to define the challenges of blockchain technology. Näf, Keller and Seiler (2021) researched the effects of cryptocurrencies on the environment, economy, and society. They conducted interviews according to the Delphi method to develop a methodology for assessing a cryptocurrencies sustainability.

However, the effect of these blockchain applications on users and companies has not been researched as thoroughly. Voskobojnikov et al. (2021) researched effects of trust, perceived self-efficacy, and risk of non-crypto adopters. They did an online survey to understand the reasons of non-adopters why they are not using crypto assets. Toufaily (2022) conducted qualitative research where interviews were held with stakeholders in blockchain and cryptocurrency ecosystems. Based on that a model was created to describe the dimensions affecting consumers trust towards crypto token-based applications.

The challenges and trust issues with blockchain have been researched, but the user acceptance of crypto miners in commercial software has not. Also, the users' view of the software producer might change when crypto miners are included into commercial software. This thesis is going to fill these gaps and give some concrete insights from a case study perspective.

1.2 Research Objective and Research Questions

The aim of this thesis is to examine whether the inclusion of a crypto miner in antivirus software is a good idea using a qualitative research approach. There is a lack of scientific research on how the inclusion of crypto miners in commercial software changes the users view about the software company. In order to achieve this goal, the following research questions were created:

1. Do antivirus software users accept crypto miners in commercial IT security software?
2. How does the users` view of the manufacturer change after the inclusion of crypto miners in their software?
3. Where do the users see the environmental responsibility of crypto mining with such feature?

1.3 Structure of the Thesis

This thesis starts with a literature check where the theoretical framework consists of blockchain, Ethereum, Gen Digital Incorporated, brand image and the technology acceptance model. The theoretical chapters are followed by the research methodology and explanations of the case-company and the semi-structured interview process. The methodology chapter also introduces how coding and analysis of the collected data was conducted and then the reliability of the study is discussed.

The next chapter presents the results of the interview data, starting with the perception of antivirus software. That is followed by the brand image of antivirus software. The same is done for the data of cryptocurrencies, followed by the data related to Gen Digital Incorporated's brand image. After this the results of perception of Gen Digital Incorporated's Ethereum miner are stated. In the end the results for the brand image change of Gen Digital Incorporated and for the perceived environmental responsibility are presented.

Discussion and conclusion chapters complement the thesis by reviewing the main findings and the limitations of the study and by evaluating the conducted research. Lastly, recommendations for future proceedings and future research possibilities are suggested.

2 Literature Review

2.1 Blockchain

Blockchain is a widely known technology in the academic and public society. Iansiti and Lakhani (2017) described it even as a transformative foundational technology. At the Davos World Economic Forum in 2018 blockchain was discussed as one as the key disruptive technologies. Experts stated that multiple financial institutions invest a lot of time and money exploring potential blockchain technology so they can improve their range of activities. (Arnold, 2018)

Confirming this statement Friedlmaier, Tumajan and Welpe (2018) found in their research that the investment in blockchain related startups sums up to 1.547 billion USD. Also, besides the financial industry blockchain has gained more traction in academia and other industries (Weking, Mandalenakis, Hein, Hermes, & Krcmar, 2019). McKinsey reported that in 2016 and 2017 more than half a million publications were added and 3.7 million Google searches concerning blockchain were done (Carson, Romanelli, Walsh, & Zhumaev, 2018).

Gartner's Hype Cycle for Emerging Technologies in 2016 supports these big numbers by showing that blockchain was reaching the peak of inflated expectations (Gartner, 2016). In 2017's Hype Cycle blockchain technology was already falling into the "Through of Disillusionment" in Gartner's research (Gartner, 2017). For 2018 blockchain continued to be in the "Through of Disillusionment" (Gartner, Gartner Identifies Five Emerging Technology Trends That Will Blur the Lines Between Human and Machine, 2018) and has since not occurred in the Emerging Technologies Hype Cycle anymore.

Therefore, blockchain technology should be in a state now where productive solutions are on the market and can be evaluated. Before we go deeper into the concrete blockchain application and its implications on Gen Digital Incorporated an overview of blockchain definitions, challenges, its most common applications, and cryptocurrencies in detail are given.

2.1.1 Definition

The first idea of peer-to-peer network or blockchain, as it is referred to nowadays, was first introduced by David Chaum in his dissertation "Computer systems established, maintained and trusted by mutually suspicious groups" in 1982 (Sherman, Javani, Zhang, & Golaszewski, 2019). The breakthrough of the technology happened with a person or group going by the name Satoshi Nakamoto in a white paper about performing transactions without the need of intermediaries (Nakamoto, 2008). The idea was intended to be a tool to disrupt and disintermediate centralized entities (De Rossi, Salviotti, & Abbatemarco, 2019). Based upon this paper they developed the cryptocurrency Bitcoin.

Blockchains can be defined in numerous ways. For example, Glaser (2017) defines blockchain as a distributed, transactional database consisting of nodes. These nodes interact via a peer-to-peer communication network with its own layer and protocol. They can identify each other by their IP addresses. Users maintain a public and a private key. The public key is for identification between users while the private key is used for cryptographically signing messages and transactions to authorize them. Beck and Müller-Bloch (2017) defined blockchain as a distributed ledger consisting of records of transactions that may involve any kind of value, money, goods, property, or votes. Walport (2016) defines a ledger as an asset database which is shareable across a multi-node network, geographies, or institutions.

Seebacher and Schürlitz (2017) also define blockchain as a distributed database which is shared on a peer-to-peer network. It consists of blocks linked in a sequence, holding transactions that are timestamped and secured by public keys and verified by the network community. As soon as an element is appended to the blockchain it cannot be altered, so the blockchain shows an immutable record of past activities.

Morabito (2017) refers to blockchain as a distributed, encrypted database, which is a public storage for information. This information cannot be reversed. Iansiti and Lakhani (2017) describe blockchain as an open, distributed ledger which records transactions between two parties efficiently, verifiably, and permanently.

Based on these definitions it can be concluded that blockchain is a distributed storage technology which logs transactions between two parties. These transactions are secured and verified via the blockchain network itself. Christidis and Devetsikiotis (2016) add to this definition that because of the missing intermediary, this will result in an acceleration of reconciliation. Nowiński and Kozma (2017) confirm that blockchain reduces inefficiencies in intermediation.

The definitions already showed some functionality of how the blockchain works but it can be described in more detail. Chhina et al. (2019) see the data structure as a linked list which is linked as a network of nodes. The nodes are entities that connect to the blockchain (Casino, Dasaklis, & Patsakis, 2018). To validate a transaction those nodes are also the decision makers. As soon as a transaction enters the blockchain, it is verified and validated in stages by the confirmation of the nodes. (Koteska, Karafiloski, & Mishev, 2017) As soon as the transaction is broadcasted it cannot be manipulated. The nodes are grouping the transactions into blocks. Nodes, which verify the blocks on the blockchain by its rules are called full nodes (Casino, Dasaklis, & Patsakis, 2018).

2.1.2 Challenges

Because of blockchain's decentralized and transparent approach it promises trust among individuals (Kewell, Adams, & Parry, 2017). Still, there are many challenges blockchain based technologies need to address.

Chhina et al. (2019) consider blockchain's challenges either technical or non-technical. The technical challenges include computational problems, like the high energy usage of validation of the blockchain or increasing file sizes, but exclude security related issues. Non-technical challenges can be categorized into organizational, governmental as well as security and privacy related challenges. Organizational challenges could be cultural resistance or a lack of infrastructure for computation. Governmental challenges can be missing governmental support, no legal laws for disputes or a lack of standardization. Security and privacy challenges include possible security threats, the majority attack or data confidentiality. (Chhina, Chadhar, Vatanasakdakul, & Chetty, 2019)

Another big challenge for blockchain applications is sustainability. Medaglia and Damsgaard (2020) state that almost no empirical research investigates blockchain against sustainable development goals. However, sustainable development has started to be the interest of blockchain research in different areas (Rossi, Müller-Bloch, Thatcher, & Beck, 2019). Blockchain also got more criticism for its high demand in resources, for example when it comes to mining the cryptocurrency Bitcoin (Vogel, Hagen, & Thomas, 2019) (Digiconomist, 2022).

When talking about sustainability of blockchain applications usually only the high energy consumption required by blockchains which are using the proof of work consensus mechanism is focused on (Becker, Breuker, Heide, & Holler, 2012). But Delliere and Grange's (2018) analysis highlights that the electricity consumption is not the only indicator that should be considered when evaluating a blockchain's sustainability. The ratios of stale and empty blocks should also be taken into account as well as the waste management practices involved in the operation of the blockchain. But the investigation of blockchains most common application, cryptocurrencies, is still in the early stages (Näf, Keller, & Seiler, 2021).

Another challenge that Iansiti and Lakhani (2017) mention is the lost trust because of Bitcoin related hacks and crypto exchange crashes. A comprehensive list of technical challenges of blockchain's first application, Bitcoin, was published by Swan (2015):

1. **Throughput:** Bitcoin has a potential throughput problem. The theoretical current maximum of transactions per second (tps) is seven. Compared to VISA (2,000 tps typical; 10,000 tps peak), Twitter (5,000 tps typical; 15,000 tps peak), and advertising networks (>100,000 tps typical) it cannot keep up.
2. **Latency:** One Bitcoin transaction block needs about 10 minutes to process. Therefore, a transaction can earliest be confirmed after at least 10 minutes.
3. **Size and bandwidth:** If Bitcoin would be handling similar amounts of transactions as VISA, it would produce about 3.9 GB/day for every decentralized node of the whole network.
4. **Security:** The most threatening possibility is a 51-percent attack, in which one mining entity can become powerful enough to record all transaction activity. Double spending is another vulnerability where users get tricked into sending tokens twice.
5. **Wasted resources:** Energy consumption and e-waste is created for the sole purpose of proof of work validation.
6. **Usability:** Bitcoin's application programming interface (API) is not as easy to use as widely used representational state transfer (REST) APIs.
7. **Versioning, hard forks, multiple chains:** With big mining pools dominating Bitcoin and other cryptocurrencies, it is rather easy for them to 51-percent attack smaller blockchain applications. Also, splitting code into branches and merging changes is difficult with blockchains so far.

These challenges must be overcome by possible blockchain applications. Based on which field the application is used in, the importance of different challenges varies. Previous studies have explored already different blockchain applications (Rossi, Müller-Bloch, Thatcher, & Beck, 2019) which will be highlighted in the next chapters.

2.1.3 Cryptocurrencies

Already in November 2020 CoinMarketCap, an online trading platform for crypto tokens, listed over 6000 different cryptocurrencies with a total market cap of over 450 billion USD

(Voskobojnikov A. , Abramova, Beznosov, & Böhme, 2021). In November 2022 the number of cryptocurrencies has more than tripled to 21.640 and the total market cap also more than doubled to over 1 billion USD (CoinMarketCap, 2022). In a survey from ING (2018) they found out that 0.9 out of 10 Europeans have already purchased cryptocurrencies. Additionally, about 35% of Europeans think cryptocurrencies are the future of spending online (ING, 2018). Also, in developing countries cryptocurrencies have found users where mobile money (e.g., M-Pesa) is already being used (Mules, 2020).

In cryptocurrencies parties can exchange the tokens they receive for validating blocks. Näf et al. (2021) declare crypto-tokens as immaterial goods. These tokens are of indirect nature and do not experience wear and tear. Copying or deleting them does not produce any emissions. (Näf, Keller, & Seiler, 2021) Hileman and Rauchs (2017) categorize cryptocurrencies in four use-cases: investments, medium of exchange, payment rail, and non-monetary use cases. Especially the non-monetary usage became prominent for example with Ethereum (Wood, 2014) enabling executable code for smart contracts.

The majority of research on cryptocurrencies has been about Bitcoin, the first blockchain based application directly based on Nakamoto's white paper. Bitcoin is a peer-to-peer electronic cash application which allows users to send payments directly from one party to another without any financial institution. (Nakamoto, 2008)

Li and Wang (2017) researched the determinants of Bitcoin's exchange rates. Gao et al. (2016) interviewed ten users and ten non-users of Bitcoin to find out how their environment framed their perception of the currency. Voskobojnikov et al. (2020) researched the perception of risk among north American cryptocurrency users and non-users. Abamova and Böhme (2016) analyzed a questionnaire from 86 respondents about their view of benefits and risks with Bitcoin trading. The impact of trust and self-efficacy on the adoption of non-users has not been studied so far (Voskobojnikov A. , Abramova, Beznosov, & Böhme, 2021). Adoption behavior has only been researched with similar topics like mobile banking (Kim, Shin, & Lee, 2009) (Luo, Li, Zhan, & Shim, 2010) or Internet in general (Kesharwani & Bisht, 2012) (Yousafzai, Pallister, & Foxall, 2005) (Chaudhry & Yousaf, 2018) (Garriga, Arias, & De Renzis, 2018) where the three factors: risk, perceived self-efficacy and trust are significant to the adoption behavior.

When it comes to sustainability, most studies only focus on Bitcoin's energy consumption (Stoll, Klaaßen, & Gallersdörfer, 2019) (Krause & Tolaymat, 2018) (de Vries, 2018) (Vranken, 2017). Most often cryptocurrencies are only compared by non-quantifiable criteria in academia (Hazari & Mahmoud, 2019) (Zhang & Lee, 2020) (Bach, Mihaljevic, &

Zagar, 2018). In non-scientific comparisons the aim is solely on investment recommendations (Weiss Ratings, 2022) (TokenInsight, 2022). Generally speaking, there is still a research gap of scientifically derived methodology with quantifiable criteria to compare different cryptocurrencies for their sustainability (Näf, Keller, & Seiler, 2021).

2.1.4 Other Applications

Da Cunha, Soja and Themistocleous (2020) found out that financial applications are still the most dominant application based on blockchain, but they are not limited to cryptocurrencies any longer. International money transfer, micro-credit, micro-insurance, and efficiency of traditional banks also have been realized (da Cunha, Soja, & Themistocleous, 2020).

Besides financial applications, blockchain technology fits great to supply chain or decentralized trading services because of its data integrity (Yli-Huumo, Park, & Smolander, 2016). Blockchain's capability of real-time updating data also benefits stakeholders along the supply chain (Casey & Wong, 2017) by keeping all databases synchronized (Christidis & Devetsikiotis, 2016).

Further research focuses on blockchain applications in the healthcare sector (Gammon, 2018) or in social networks (Ciriello, Beck, & Thatcher, 2018). Often these applications are based on smart contracts, which is a way of storing algorithms in the blockchain and therefore assuring that they will be executed (Buterin, 2014). With these smart contract applications within business process management (Mendling, Weber, Van der Aalst, & vom Brocke, 2018), accounting (Dai & Vasarhelyi, 2017), Fintech (Gomber & Parker, 2018) or e-government (Ølnes, Ubacht, & Janssen, 2017) are possible. However, only limited research exists about blockchain's use in government, its governance, and its creation of value (Risius & Spohrer, 2017).

Andoni et al. (2019) see an immense potential to use blockchain in energy related products and commodities. As soon as the products become digital, they are interoperable with blockchain technology. Al-Jaroodi and Mohamed (2019) go even further and add manufacturing, agriculture, food, robotics, entertainment, and construction domains to the possibilities of blockchain applications. Besides the opportunities, Al-Jaroodi and Mohamed (2019) diagnosed that there is still further research to be done to create a more workable and effective blockchain application that fully benefits the use of blockchain and achieve its goals. Also, Glaser (2017) states that concrete business applications and further development of blockchain remains uncertain.

2.2 Ethereum

Buterin (2014) published in 2014 a white paper as the foundation of a new blockchain based framework called Ethereum. The main reasons for this new blockchain framework were, according to Buterin, the limitations of Bitcoin's stack-based script language. Buterin (2014) mentioned that Bitcoin was already able to facilitate a weak version of smart contracts but because of Bitcoin's flaws, the implementations had issues. He mentions four flaws of Bitcoin which moved him to develop Ethereum:

1. **Lack of Turing Completeness:** The scripting language does not include all necessary computations developers need. The biggest problem is missing loops. This leads to long space consuming code.
2. **Value-blindness:** Bitcoin scripts do not have fine control over the withdrawable amount.
3. **Lack of state:** Bitcoin can either be spent or unspent. No further states are possible and limit the possibility of multi-state applications.
4. **Blockchain-blindness:** Unspent transaction outputs (UTXO) have no information about blockchain data such as the nonce or the previous hash. This limits the application use-cases where this valuable source of randomness would be beneficial.

Buterin's intention of Ethereum was to merge together and improve the already existing blockchain concepts and create a scalable, standardized, feature-completed, easy to work with and interoperable framework with which developers are able to create consensus-based applications. Ethereum would be an abstract foundational layer with a programming language used to create whatever application a developer might desire. Ethereum accomplished this by its design. (Buterin, 2014)

In general, Ethereum is made out of objects called accounts. Any interaction between accounts is called a transition, in which a direct transfer of value and information is logged. An Ethereum account contains the nonce, which is a counter to track the order of transactions, the account's current ether balance, the account's contract code (optional) and the account's storage (empty on default).

There are two types of accounts. An external account contains no code and is controlled by a private key and a contract account that is controlled with the contract code.

External accounts can send messages when they sign a transaction to other accounts and contract accounts only act when they receive a message. Contract accounts can then write to the internal storage and send other messages or create contracts in turn. The Ethereum messages can be seen like transactions in Bitcoin, but with a few differences. First, Bitcoin transactions can only be created externally while Ethereum allows contract accounts to create messages. Secondly, Ethereum messages can explicitly contain data. And last, Ethereum messages can receive a response by a contract account acting as a function. (Buterin, 2014)

The transaction within a message contains a signature defining the sender, the amount of ether (Ethereum's native cryptocurrency) and data send as well as STARTGAS and GASPRICE. STARTGAS is the ether limit on how much the transaction is allowed to consume before it gets cancelled. This is useful so the transaction is not exponentially blowing up in case an infinite loop is in the code. GASPRICE is the ether fee that is paid to the miner per computational step. If during the transaction execution the STARTGAS is running out, all state changes are reverted – except the fees that have been already paid. If there is STARTGAS remaining after the successful execution of the transaction the sender receives the remaining ether back. (Buterin, 2014)

Similar to Bitcoin the rest of the blockchain functionality, distributed ledgers, creating and validating blocks, are handled the same. The more blocks are mined, the longer it takes to find the next one, creating an exponential difficulty for validating blocks.

2.2.1 Proof of Work

From its launch on 30 July 2015 until 15 September 2022, Ethereum used the so-called proof of work (PoW) mechanism. Originally introduced by Dwork and Naor (1993) as a way of combating email spam, PoW is the idea of requesting a user to present a solution to a problem that is harder to solve than to verify (Becker, Breuker, Heide, & Holler, 2012).

In cryptocurrencies PoW is used to validate transactions and form a lottery for every participating entity. So-called miners offer their computational power to calculate hash values and the more computational power invested, the higher the chances of winning are. If a miner wins, they are rewarded with a number of crypto tokens from the blockchain they are mining for, as well as the fees the users had to pay to get their transaction listed in the current block.

In case multiple blocks claiming to be the correct next one emerge, the one which has the most PoW will be chosen. This secures the blockchain and only in case a single malicious entity has more than 50% of the overall computational power in a blockchain it can be manipulated (Becker, Breuker, Heide, & Holler, 2012).

Because this validating lottery is based on computational power the sustainability of cryptocurrency using PoW has been heavily criticized and many researchers have seen the energy consumption as one of the main factors of cryptocurrencies' sustainability (Näf, Keller, & Seiler, 2021) (da Cunha, Soja, & Themistocleous, 2020) (Hileman & Rauchs, 2017).

2.2.2 Proof of Stake

Proof of stake (PoS) is another mechanism to create and validate block in a blockchain without competition between miners (Hazari & Mahmoud, 2019). In case PoS is used, the amount of total currency in the blockchain remains fixed. Instead of miners trying to find the next block first, a validator is chosen in a pseudo-random way. This elected validator can validate the next block. To become a validator, one must put some of their own currency at stake, therefore the name proof of stake. Once a block is created the randomly selected validator gets the fee of the transactions as a reward. The stakes are returned to the validators.

Hazari and Mahmoud (2019) mention one bottleneck of PoS. Users who can put more currency at stake have a higher possibility of being elected as validator. To solve this issue pseudo-random algorithms have been proposed.

Ethereum's switch to PoS was planned since its launch day (Gupta, 2015). It took multiple years until the change to PoS took place on 14 September 2022. Until that Ethereum remained the second largest energy consuming blockchain (Krause & Tolaymat, 2018), after Bitcoin. Buterin, Ethereum's inventor, already wrote in 2013 in Bitcoin Magazine about proof of stake and why it matters for the future of cryptocurrencies (Buterin, 2013).

With the switch to PoS, this thesis was affected. On the 14 September 2022 NortonLifeLock Incorporated announced that with the change of Ethereum to proof of stake their crypto mining solutions Norton™ Crypto and Avira Crypto will be disabled (NortonLifeLock Inc., Attention :: An Important Norton Crypto Announcement, 2022) (Avira, 2022). No further plans of mining a different cryptocurrency have yet been published.

2.3 Brand and Technology Acceptance

Consumers buy products and services based on a variety of different factors. Companies try to address many of those factors by establishing brands for their products that fit the target group. Yang and He (2012) state that brand research in general is done to enhance the enterprise's brand competitiveness on the market. Zhang (2015) points out that with the proliferation of brands the purchase decision is largely based on the brand image rather than the brand itself. He also found in his research that besides the change of consumers lifestyle, the brand image remains the dominant consuming decision.

2.3.1 Brand Image

According to Zhang (2015) brand image is the general feeling and perception of a consumer towards a brand, which also affects the consumers behavior. Chen, Yeh and Huan (2014) found in their research that brand image directly strengthens the customers' purchase intention. Brown (2009) also recommends a positive brand image to increase customers' personal pleasure as well as identification with the brand. According to Tu et al. (2012) a positive brand image is an intangible value for consumers which increases their confidence in the brand.

While the importance of brand image is universally agreed upon, Zhang (2015) found in his research that the definitions of brand image can be divided into four different perspectives.

1. **Blanket Definitions:** According to Herzog (1963), Newman (1985) and Dichter (1985) brand image describes the general view of a product or service.
2. **Meanings and messages:** Noth (1988), Sommers (1964) and Levy (1973) rather see brand image as the symbolic part of a product or service.
3. **Personification:** Martineau (1957), Bettinger et al. (1979) and Sirgy (1985) define brand image as the representation of the customers self-perception. According to Bellenger et al. (1976) consistency between brand image and the consumers self-image strengthens the satisfaction, loyalty, and identification with a brand.
4. **Cognitive or psychological elements:** Garner and Levy (1955), Levy (1978), Bullmore (1984) and Kapferer (1994) define brand image based on the consumers opinion and feelings towards the brand as well as the recognition and attitude the brand reflects.

Companies can try to create or change a brand image in different ways. For example, Keller (2003) suggests that companies should create a connection between the strong brand associations with consumers' memories with the help of a marketing campaign. Lassar et al.

(1995) describe the five areas in which companies need to act to affect the brand image. First, a brand needs to perform the way it is designed, second, the social image with purchasing or owning the brand needs to be established, third, consumers' recognition and sentimental attachment towards the brand is needed, fourth, the balance of the brands value and its functionalities must fit, and fifth, the consumer needs trust in the brand.

2.3.2 Technology Acceptance

Davis (1989) and Davis et al. (1989) developed in the late 80s the technology acceptance model (TAM) which is based on a widely accepted intention theory of reasoned action from Fishbein and Ajzen (1975). The model is used to break down the reasons of why consumers adopt new technologies to two main beliefs: the perceived usefulness of using the technology and the perceived ease of use of the technology.

Tractinsky (2004) found in his research that personal IT products usually have a satisfactory level of function and usability and therefore the ability to create favorable user emotions becomes a distinguishing factor. Liu and Karahanna (2007) also state that emotional attachment to a brand can directly or indirectly influence the evaluation of a brand.

One way to create these positive emotions is building brand trust. Liu and Karahanna (2007) say that beliefs about reliability, safety and honesty are important factors. Delgado-Ballester et al. (2003) see brand reliability and brand intentions as the two main components of brand trust.

So, in order to get a new technology accepted the new technology needs to be useful to the user and easy to use. If these factors are met by multiple products the users' emotional view of the product or service is needed to succeed. Creating a brand trust with a reliable view and good intensions is favored.

3 Methodology

3.1 Case company - Gen Digital Incorporated

In order to find the right methodology, we need to first take a look at the case this thesis will be based on. Gen Digital Incorporated is since the 7 November 2022 the new name of the company formerly known as NortonLifeLock Incorporated. The American based cybersecurity company is based in Tempe, Arizona and has around 500 million users in more than 150 countries (Gen Digital Inc., 2022).

Before known as NortonLifeLock Incorporated, Gen Digital Incorporated was also known as Symantec Corporation, which was founded in 1982. After over 30 years with the same name and many mergers and acquisitions, the company renamed itself in 2017 to NortonLifeLock Incorporated after the acquisition of LifeLock Incorporated. In 2019 NortonLifeLock Incorporated was bought for 10.7 billion USD by Broadcom Incorporated, an American semiconductor and software giant (Broadcom, 2022). After the last successful merger with Czech cybersecurity company Avast on 2 September 2022 NortonLifeLock Incorporated changed its name to Gen Digital Incorporated. Overall, Gen Digital Incorporated owns nowadays several brands in the cybersecurity software space:

- Avast (Anti-Virus Software)
- AVG (Anti-Virus Software)
- Avira (Anti-Virus Software)
- CCleaner (System Security Software)
- LifeLock (Identity Security Software)
- Norton (Anti-Virus Software)
- ReputationDefender (Identity Security Software)

On the 2 June 2021 NortonLifeLock Incorporated announced the launch of a new product called Norton™ Crypto, a feature built into their already existing antivirus software platform Norton™ 360 (NortonLifeLock Inc., 2021). With this feature Norton™ 360 subscribers were able to let their computer mine the cryptocurrency Ethereum whenever the software Norton™ 360 was detecting that the computer was not used otherwise (see Figure 1).

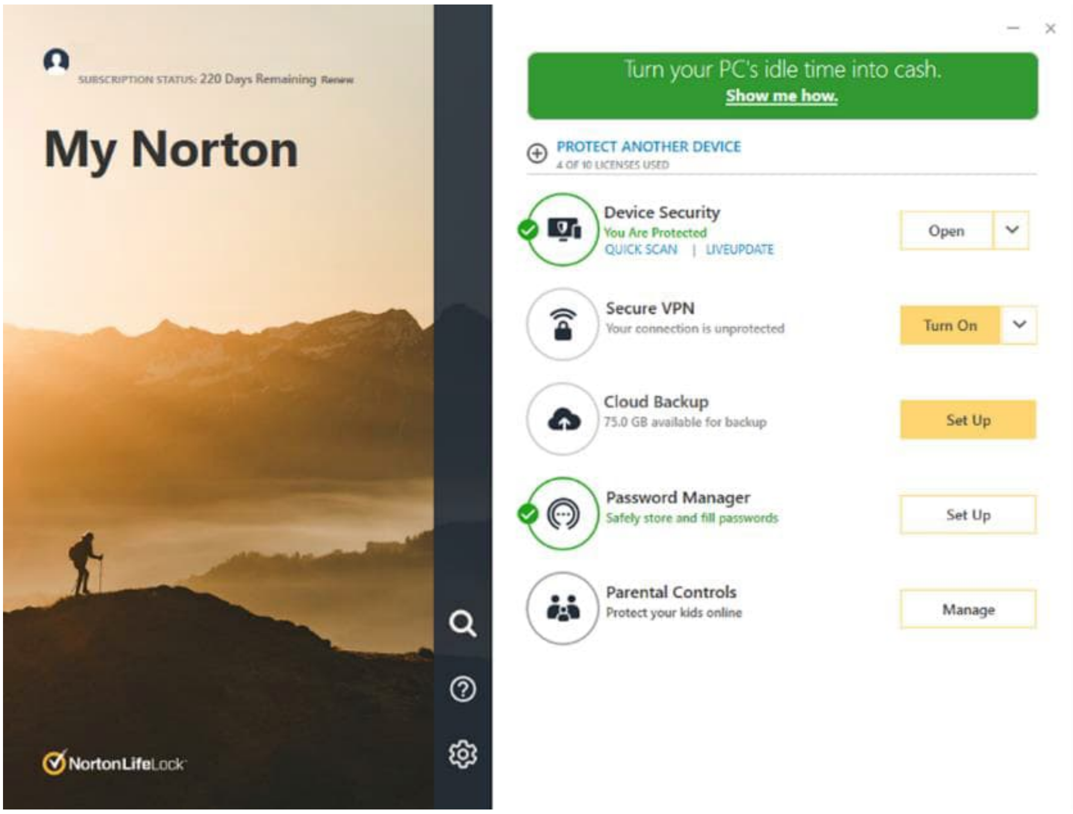

Figure 1. Norton 360 dashboard (NortonLifeLock Inc., 2021)

When users decide to use Norton™ Crypto they will get a digital wallet, handled and saved by Norton in their cloud network. A user interface (Figure 2) will show relevant data for the user to display the current hash rate with which the GPU is mining as well as how much ETH (the tokens of Ethereum) are already available for transaction.

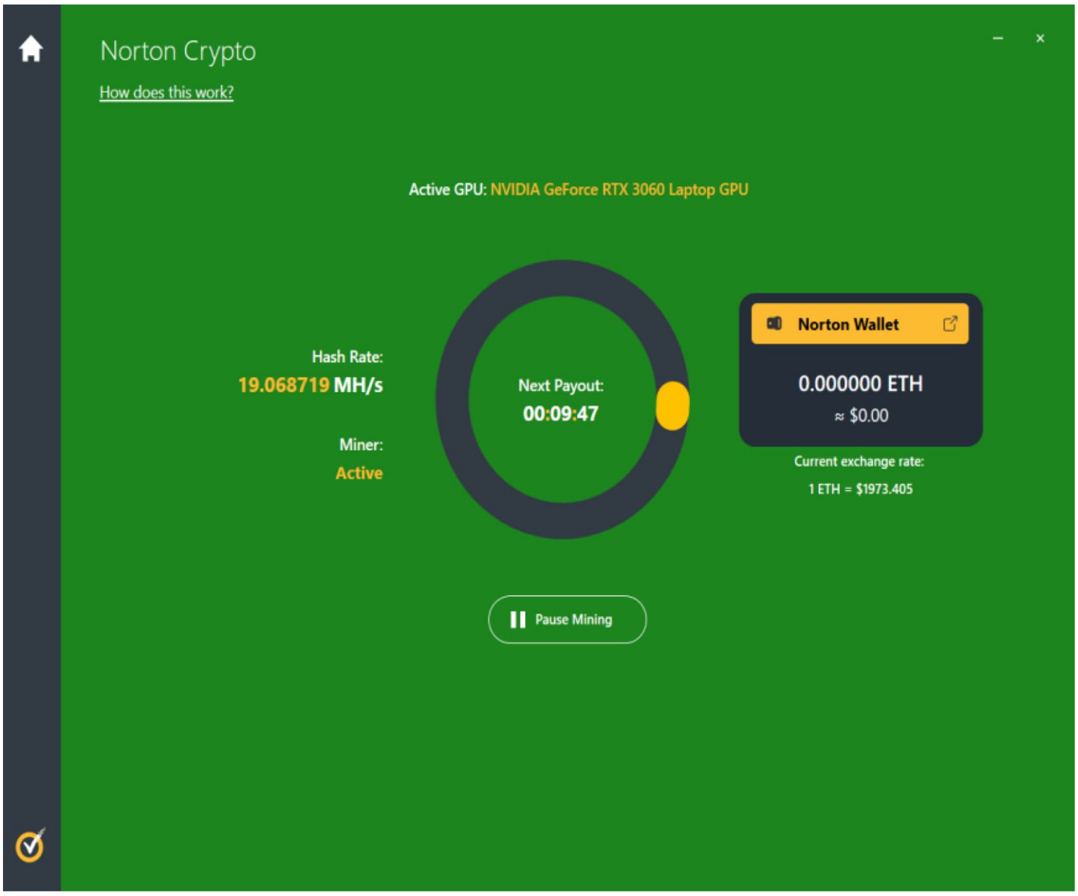

Figure 2. Norton Crypto dashboard (NortonLifeLock Inc., 2021)

From the earnings a user generates, a fee of 15% is rerouted to NortonLifeLock Incorporated themselves. If a user wants to liquidate their ETH they can transfer it to a wallet on the cryptocurrency exchange platform Coinbase. (NortonLifeLock Inc., 2021)

From the 3 June 2021 onwards selected customers were invited into the early adopter program to mine Ethereum (NortonLifeLock Inc., 2021). About a month later, on the 20 July 2021 NortonLifeLock Incorporated officially released the product for US customers (NortonLifeLock Inc., 2021) Over half a year later, on 18 January 2022 NortonLifeLock Incorporated announced the availability of Norton™ Crypto in United Kingdom, Canada, Switzerland and Italy (NortonLifeLock Inc., 2022).

NortonLifeLock Incorporated was not only the owner of the Norton™ cybersecurity brand in 2021 but also Avira Antivirus belonged to them. Therefore, in a similar timeline on the 27 October 2021 Avira announced their crypto mining solution Avira Crypto with basically the exact same features as Norton™ Crypto (Figure 3) for the US, Canada and the United Kingdom.

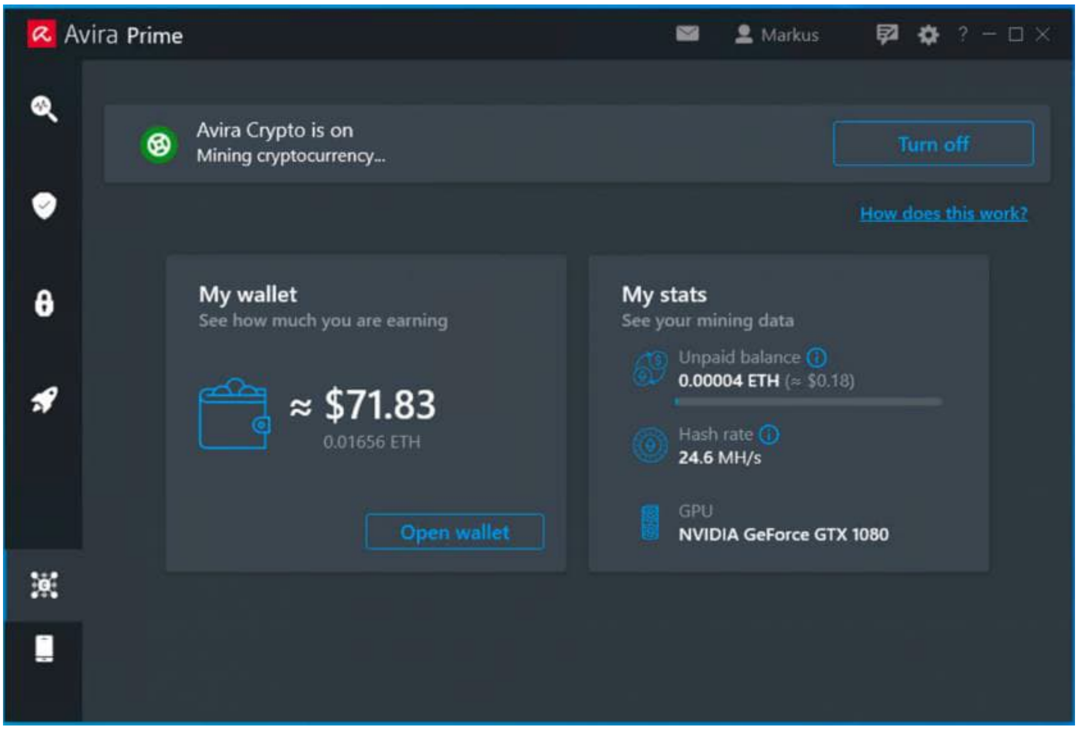

Figure 3. Avira Crypto dashboard (Brenner, 2021)

Since NortonLifeLock Incorporated (2021) announced on the 10 August 2021 the merger with Avast it is not unlikely that the plan also included to rollout a crypto miner solution for Avast's antivirus products in the following months after the merger completed.

In Gen Digital Incorporated's latest quarterly report for their Q2 for fiscal year 2022, just after the merger with Avast, they claim to have gained 16.6 million new directly paying users in the last three months adding up to a total of 38.6 million direct paying customers. These numbers do not include customers who use a premium model purchased over a third party. (Gen Digital Inc., 2022)

3.2 Research Method

To get the data needed to answer to the research questions, a suitable research method must be defined. The goal of this thesis is to get insights if the inclusion of a cryptocurrency miner in antivirus software is a good idea from a user's perspective. This kind of study falls into the area of natural social life and business. For this kind of research Saldana (2011) recommends qualitative research. No other company has so far included a cryptocurrency mining component to any mass market IT security software product, so comparisons cannot be made yet. Therefore, also no previous research on the effect of such a component exists yet. The novelty of this research supports the choice of a qualitative research approach and the nonquantitative character of the data that is needed to analyze it.

The focus of this study is on a single company and its business practice; therefore this research will be conducted as a case study. Other genres of qualitative research, such as grounded theory or content analysis can be excluded. Case studies concentrate on a single unique case and besides the limitation on one subject, diverse experiences and perspectives can be collected from participating individuals (Saldana, 2011), which is needed for this research.

Saldana (2011) mentions different approaches for data collection in qualitative research. These are for example, interviews, observations, documents, and media materials. Interviews are by far the most common data collection method. Observations are held in the field to gather daily life impressions of the participants. When using documents as a source of data, researchers focus on documents that contain text and images that reflect their creators' ideologies and values. Media material can be internet sites, e-mails, blogs, or forum entries. (Saldana, 2011) Out of these methods interviews are the best way to gather the needed information for this research. According to Saldana (2011) interviews are an effective way to gain an understanding of the individuals' perspective and opinions in their own words. Using interviews in this thesis will give great insights on the view the participants have concerning the case.

Interviews can be structured, semi-structured or not structured at all. They can also be planned and scheduled or be spontaneous. The more open interviews are, the more insights on unexpected areas can be generated for further inquiry. They can be held with a single person or with a group of participants. If needed interviews can be held multiple times with the same individual. (Saldana, 2011)

For this case semi-structured interviews are the best fit. They allow to ask needed information from the participants, for example their knowledge on the topic, and give still opportunity to have deeper spontaneous discussions. Galletta and Cross (2013) highlight the variation in the use of semi-structured interviews: it is possible to use variation in questions, prompts and accompanying tools. The questions can be both open-ended and more theory-driven to ground the data from the participants to literature and guide the interview in the discipline of the research. However, each interview question must be clearly connected to the purpose of the research. (Galletta & Cross, 2013)

3.3 Semi-structured Interviews

Since no research about the influence of a cryptocurrency miner in any software, especially IT security related ones, exist, this research aims to create empirical data based on qualitative research in form of one-on-one interviews. The interviews were held in a semi-structured way with each participant over a Microsoft Teams meeting. The questions were kept open-ended to encourage discussions outside of the question catalogue. The goal of the interview was to figure out who the participants are, what they know about antivirus software brands and cryptocurrencies, and what they think about the business practice and Gen Digital Incorporated itself. The discussion guide used in the interviews included questions about the usage behavior with antivirus software, the trust the interviewees have towards IT security software providers, the knowledge and opinion of cryptocurrencies and crypto mining as well as information about the case to create a non-biased opinion. After the information about the case, each participant was asked a few questions regarding the change in their view on the software and company and the relevance of positive and negative factors.

Interviewees were given room to give information outside of the questions catalogue to elaborate their opinions further with own examples and follow-up questions. The semi-structured style helped a lot with providing additional data outside of the predefined scope of this thesis. This way relevant topics were mentioned that were not identified earlier.

The interviews' duration ranged between 30-60 minutes, and they were recorded and transcribed with Microsoft Teams' recording and transcribing tool. Some interviews were held in English and some in German. The German interviews were translated afterwards into English. The guide used for the interviews can be seen in the appendix A.

In the interview the interviewees were first asked about their opinions of built-in antivirus software and dedicated antivirus software to present a baseline of how they stand with antivirus software in the technology acceptance model by Davis (1989) and Davis et al. (1989). They also elaborated their personal experiences with brands they used and why they chose them. These viewpoints were put in line with the brand image factors mentioned by Lassar et al. (1995).

This process was replicated with the participants view about cryptocurrency technology in general and followed by a brand image discussion of cryptocurrencies. If needed, all interviewees were given information about how antivirus software and cryptocurrencies work, with examples of positive and negative impacts these technologies bring with them.

As the next step the discussion was aimed at Gen Digital Incorporated with a brief overview of the company's history and its brands. The interviewees were given space to communicate their view about the brands and their previous experiences with them.
For the last part the interviewees got a neutral overview of the Ethereum mining feature Gen Digital Incorporated included in two of their dedicated antivirus software solutions. Then they were asked about their opinions of the feature and the change of their view about Gen Digital Incorporated as a company. In the next chapters these results are presented.

3.4 Sampling

Ten antivirus software users with varying levels of knowledge on antivirus software and cryptocurrencies were interviewed. Their academic levels ranged from Bachelor to Master. There were no main criteria that the participants had to fulfill.

The interviewees can be seen in table 1. They were selected by convenience, ranging from family to friends since no dedicated target group could be identified. Of the ten interviewees nine live in Germany and one in Finland. For a gender-neutral approach four of the interviewees were female and six male. All of the interviewees were full time working and between 27-31 years old. Everybody received pseudonyms to ensure anonymity when reporting the results. The interviewees' knowledge on cryptocurrencies and antivirus software was rated after the interviews into three levels:

- Low: Participant did not know the general idea of the topic or explained it wrong
- Medium: Participant had a basic understanding of the topic
- High: Participant had a good understanding of the topic

Table 1: Interviewees

ID	Pseudonym	Job	Location	Education	Knowledge Crypto	Knowledge AntiVirus	Gender
1	Julia	International Relations Advisor	Finland	Master	Low	High	Female
2	Paul	Screen/ UI designer	Germany	Bachelor	High	High	Male
3	Frank	Client Lead	Germany	Bachelor	High	High	Male
4	Tim	Project Lead	Germany	Bachelor	Low	High	Male

5	Oliver	Project Lead	Germany	Master	High	High	Male
6	Lisa	Inside Sales	Germany	Bachelor	Medium	High	Female
7	Anna	Biological Technical Assistant	Germany	Master	Low	High	Female
8	Ella	Technical Support	Germany	Master	Medium	High	Female
9	Thomas	Product Manager	Germany	Master	Low	High	Male
10	George	Process engineer	Germany	Bachelor	Medium	High	Male

3.5 Coding and Analysis

The coding of the interviews was done with Excel because the number of individual interviews was not too high to require dedicated software like Atlas.ti. First the transcripts were structured into manageable text blocks containing the data that is needed for the analysis. Auerbach and Silverstein (2003) call this phase “Making the text manageable”. In this process 298 pages of transcribed interviews were analyzed and not needed data discarded.

According to Gioia, Corley, and Hamilton (2013) the next step is to make a first order of codes which are then narrowed down into a second order of reoccurring themes. So, each interview was then analyzed for opinions and experiences and shortened into codes. These codes were narrowed down, based on similarities into a second order of reoccurring themes. The first order of codes consisted of around 50 codes ranging from “dedicated antivirus software was recommended” to “financial incentive too low to try cryptocurrencies”.

Groups of the codes resulted in the second order themes. These according to Gioia, Croley and Hamilton (2013) should illuminate the larger narrative. For example, themes like “Antivirus Software Views” or “Cryptocurrency Views” were created. As a last step, Gioia, Croley and Hamilton (2013) aggregate the themes into dimension which are based on the underlying theory of the research. The coding themes were then brought in connection with the literature concerning technology acceptance by Davis (1989) and Davis et al. (1989) and the brand image factors from Lassar et al. (1995). Lastly the environmental factor, which is not accounted for in the technology acceptance model or brand image was added as an individual dimension. In Figure 4 the codes, themes, and dimensions of the topic antivirus software in general are displayed.

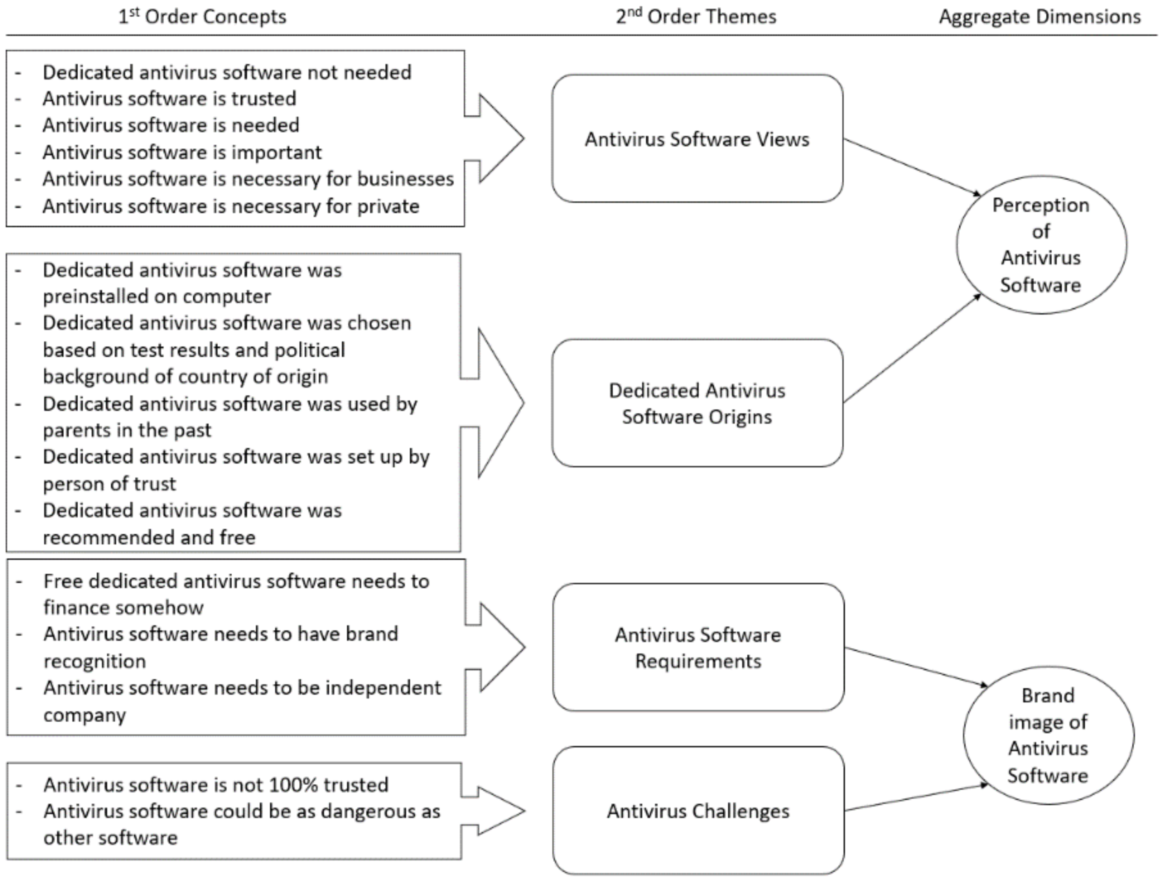

Figure 4. Antivirus Software Coding

Figure 5 displays the codes, themes, and dimensions of all data concerning cryptocurrencies.

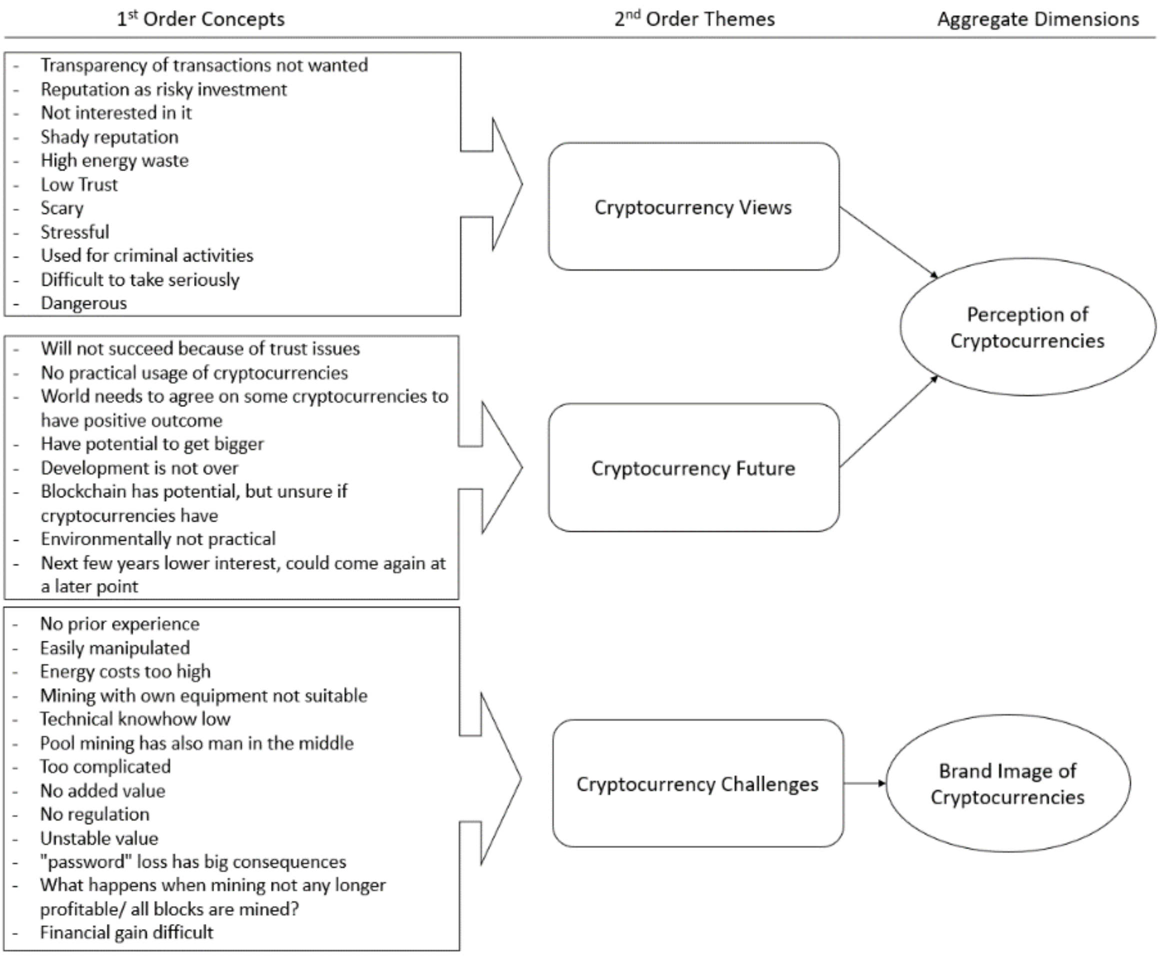

Figure 5. Cryptocurrency Coding

In Figure 6 the codes, themes, and dimensions belonging to Gen Digital Incorporated, and the environmental impact are shown.

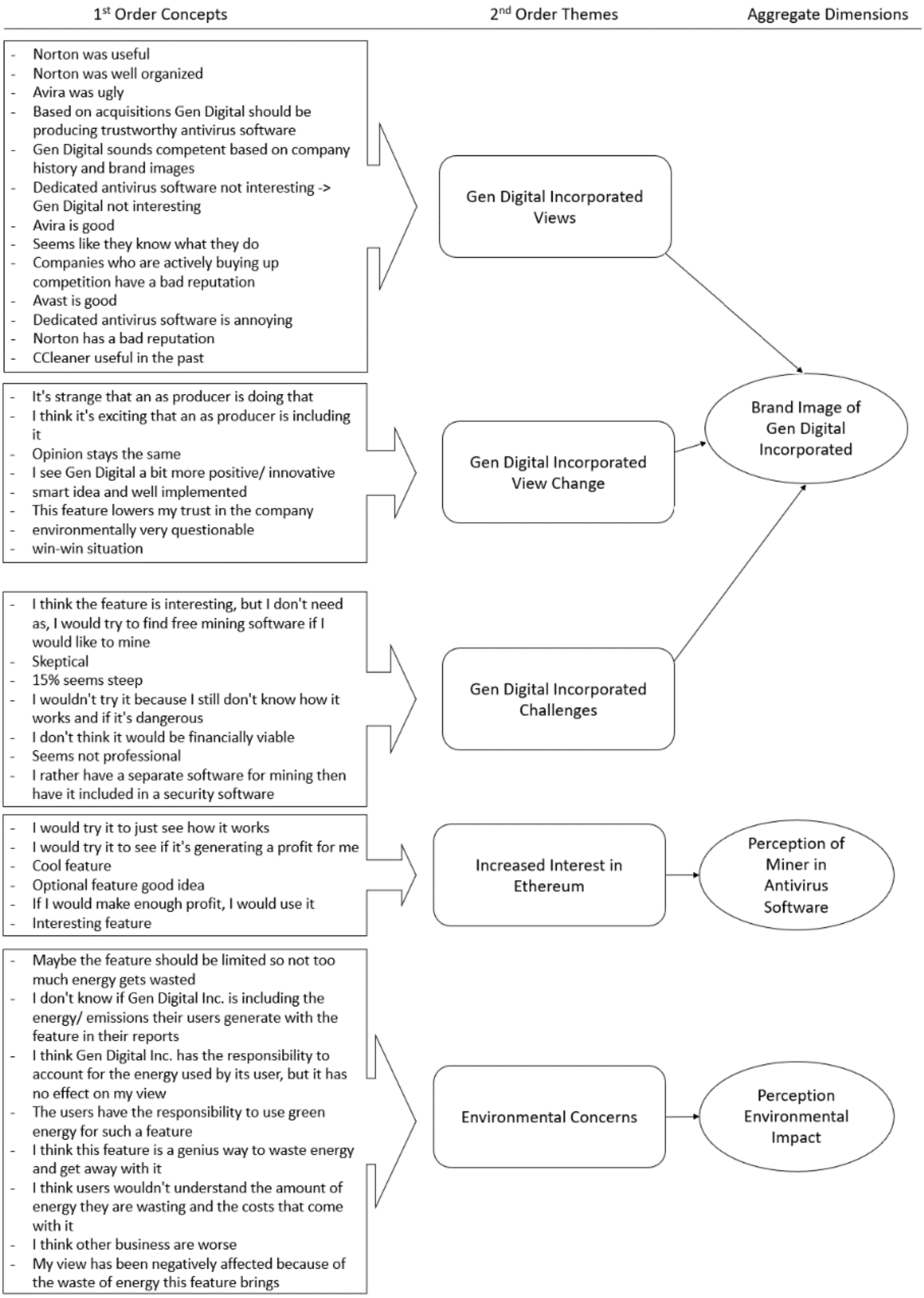

Figure 6. Gen Digital Incorporated Coding.

This layered approach for each category helped creating an understanding for the reasoning of each participant. In this case the opinions of each topic are essential to gain conclusive results.

3.6 Reliability of the Study

As with any qualitative study, reliability is a difficult issue. A reliable study creates credible conclusions and interpretations that are repeatable with the same results. For qualitative studies Saldana finds credibility and trustworthiness more appropriate (Saldana, 2011). The credibility relates to the believability of the actor's presentation. The story needs to be convincing: the number of participants interviewed, analytical methods used, and logical conclusions drawn from results need to be purposeful (Saldana, 2011). In this thesis the aim is to be as transparent as possible with the whole interview process. For example, the number of participants is clearly stated, and the analytical methods used to structure the obtained data is explained thoroughly. Conclusions are drawn directly from the presented results and is interpreted in line with the introduced theory.

According to Saldana (2011) some ways to establish credibility are citing the key writers and by specifying the analytical methods used to analyze the data. Key writers are responsible for foundational research in a certain topic, and they must be mentioned when discussing about their field of work. In this research the key writers are the inventors of the first big cryptocurrency Bitcoin, Nakamoto, and for Ethereum in this case, Buterin, as well as the founders of the technology acceptance model Davis (1989) and Davis et al. (1989).

Trustworthiness provides insight on the research process itself by informing the reader about different aspects of it. This can be done by giving detailed information about the data collected or duration of fieldwork (Saldana, 2011). For this thesis the interview process and its steps are described.

4 Results

The participants talked about their opinions and emotions towards antivirus software, their view about cryptocurrencies, Gen Digital Incorporated's brands, and the feature Gen Digital Incorporated used to mine Ethereum with. To get to the point, if Gen Digital Incorporated had a good idea to include such a feature in their antivirus software, the results need to be structured in a meaningful way. The feature can't be used without the dedicated antivirus software Norton360 or Avira Antivirus from Gen Digital Incorporated, so the users need to not only accept the technology of Ethereum mining but also the underlying antivirus software.

4.1 Perception of Antivirus Software

The interviewees had a uniform answer to the question of the usefulness of antivirus software. All agreed that antivirus software is needed and important for private and commercial devices.

Lisa, an inside sales employee, spoke about the added security through antivirus software and the help it provides for monitoring background tasks.

> *"Yes, I think it's very important, also for private use. Nowadays many evil things can reach you fast and in your daily doing. Many of them you aren't even noticing. I think it's important that something like that exists and is available for free. My trust is for sure higher than without any security at all."*

The opinions on dedicated antivirus software vs built-in software differed quite a lot between participants. Paul, a screen and UI designer, said there is no advantage in getting a dedicated software over the built-in solution.

> *"Because it [Windows Defender] is enough. I don't understand the benefit of a dedicated antivirus software."*

Also Tim, a project lead, said that to his knowledge a dedicated antivirus software is not needed because the built-in one in Windows is good enough. He does not want to pay for a dedicated solution which is not as well integrated and doesn't necessarily provide a better protection.

> *"As far as I know, it [Windows Defender] is enough and the other antivirus solutions aren't free or at least they aren't integrated as well and do not offer necessarily higher protection."*

Frank, a client lead, stated he uses the built-in antivirus software because it doesn't bother him like free dedicated antivirus software often does.

> *"Because it [Windows Defender] was built-in, and it doesn't bother me. Nothing jumps in the foreground. It does what it should."*

On the other hand, participants like Oliver, a project lead, uses dedicated antivirus software because he got it installed from a trusted person who provided him with the computer in the first place.

> *"A family friend set up my PC and he installed the antivirus software. It was for free. It never had any negative aspect, no problems ever showed up. I also never had a virus or if something happened it showed up and I was able to remove it."*

Lisa also mentioned that she uses a dedicated antivirus software based on a recommendation and the fact that it is free and working as indented.

> *"I'm using Avira because it was recommended to me. And it is free. I have the impression it works and that's enough for me. The user interface is quite user-friendly, in the way, that it shows me warnings and tells me if it found something that should be deleted."*

Overall interviewees always highlighted the usefulness of antivirus software and pointed out the biggest flaw of dedicated antivirus software to be the lower ease of use when compared to using the built-in solution. Trust plays a big role in adopting dedicated antivirus software. Many participants only used dedicated software because a person of trust recommended them to do so.

4.2 Brand Image of Antivirus Software

Getting a meaningful brand image insight of all antivirus software solutions available is out of scope for this case study. The interviewees were therefore asked to give their reasons why they chose their software and what negative or positive experiences they had. These specific experiences can still be used to generalize opinions about built-in and dedicated antivirus software solutions which result in a brand image view.

For example, Paul had a negative experience with the free version of Avira Antivirus, which he had to disable because the performance of his computer was affected by background checks and updates.

> *"Avira was getting in my way, so I had to turn it off. Of course, you shouldn't do that, but sometimes it did, without asking, likely because I didn't set it up correctly, background checks which caused performance issues while I did other stuff. When it does updates and some system checks without asking, it bothers me."*

But nevertheless, when he was asked about his general view about antivirus software, he mentioned his high trust towards them.

> *"I would say I have a higher trust towards them, otherwise I wouldn't use them."*

He later explained his concerns with free antivirus software programs.

> *"With free antivirus providers? How can they finance themselves? You must ask yourself about the software you are using there are people behind it and they want to get paid. Where does the money come from? Maybe they receive donations, or they use your data? When I use Windows Defender, I pay about 100€ for it with my Windows license."*

George, a German process engineer, also mentioned his family used to use Kaspersky, a Moscow based cybersecurity software. After the start of the invasion war in Ukraine in 2022 they informed themselves of alternatives and changed to F-Secure, the recommended product from an independent testing institute.

> *"Kaspersky actually, because I had the license from my dad. And then we changed to F-Secure now because of the political situation. We said okay, we don't want to have a Russian antivirus software on our computers because of course you need to trust it completely and therefore we said we change to F-Secure, which is a Finnish company, whose headquarters are in the European Union and that's more trustworthy to us. And F-Secure was the winner of a test from Stiftung Warentest, a German independent institute which tests hundreds of products by experts."*

Tim was annoyed of dedicated antivirus software because they interrupt the user too often with notifications and advertisement.

> *"So, dedicated antivirus software is often rather annoying. They annoy often with notifications; I remember that very well. Yes, they wanted you to download additional software, so you use their browser, and these notifications make always a lot of noise and need attention."*

All interviewees stated they are actively using a form of antivirus software. Most interviewees' experiences were clearly categorizable into the brand image factors and highlighted good and bad practices from the manufacturers. Many disliked the talkative nature of dedicated antivirus software, which tends to communicate more with the user than the built-in software. Overall antivirus software had a positive brand image among the interviewees.

4.3 Perception of Cryptocurrencies

Cryptocurrencies are difficult to explain and hard to understand without previous knowledge. The results of their acceptance were overwhelmingly negative. Many had problems with the usefulness of cryptocurrencies for themselves. For example, Lisa pointed out the missing advantages in comparison with Euro as a currency.

> *"For me they don't have any appeal. Why do I need them? Because Euro is a worldwide accepted currency which I can pay within maximum of 2 business days I never even thought about getting some kind of cryptocurrency."*

Regarding cryptocurrency being an investment possibility, Thomas, a product manager who received 50€ in Bitcoin by opening a trading depot, mentioned the unstable and risky value as a dangerous stress factor.

> *"I think it's a very volatile currency. I think it's dangerous for me, so I don't want to invest into it. I mean Bitcoin showed us it can exist for a while. I usually see how the Bitcoin value fluctuates and I think Wow! That would really stress me out if I had to handle more money with it."*

Also, the proof of work aspect of many cryptocurrencies was seen as problematic. Oliver said besides the complexity the energy costs for mining are too high to be profitable.

> *"Technological complexity and energy costs are too high."*

The complexity of cryptocurrencies and the underlying blockchain technology was the biggest negative contributor to the perceived ease of use. Frank had issues with the time he would have to invest to even understand what he must do to get a financial gain out of a cryptocurrency.

> *"Yes, if I could tell myself to sit down and then you must invest 2 hours and 1000€ and then you are owning proudly 0,01 Bitcoin, then yes why not? But first having to read deep into how to open an account and how to take care of everything is not worth it."*

Paul also mentioned the importance of fitting equipment which was a hurdle for him to mine cryptocurrency himself.

> *"I thought about it, if I could do it, if it makes sense, but my graphics card was not the right one and then your cooling solution must run all day and if you are not running all day then it's not profitable. It seemed like a lot of unknown factors what I would have to take care of to actually generate a profit."*

The interviewees clearly had their issues with the acceptance of cryptocurrencies. The participants saw cryptocurrencies neither useful nor easy to use. The mining was mentioned as especially difficult and unprofitable.

4.4 Brand Image of Cryptocurrencies

Cryptocurrencies are quite well known now, and every participant had at least heard of Bitcoin. Getting a conclusive overview of all cryptocurrencies is out of scope and impossible due to the high number of cryptocurrencies available. The same approach as with the antivirus software solutions was chosen and the participants were asked about their general opinion and their own experiences.

For example, Paul talked about his experience with the cryptocurrency Dogecoin. He bought 10000 coins and the value exploded. He sold with a 1500% gain and was still frustrated because only two months later, after a tweet from Elon Musk, the value rose more than 10 times higher.

> *"For example, I did, just for fun, buy 10000 Dogecoins. I didn't think that the value would raise even higher, it was already crazy. I sold at 600€ from 20€, that's enormous, but if I would have waited two more months it could have been 7000€. That really upset me. It's enough that Elon Musk sends one tweet and then this coin is*

> *somehow 10000 times more valuable than before. And I think that is terrible. That's nothing for a healthy, stable economy."*

For Frank the brand image of cryptocurrencies is still tightly connected with criminal activities. He thinks that the anonymity of the decentralized organization of cryptocurrencies can be used by questionable personalities. Also, simple problems like losing your "password" to your crypto wallet will lead to a total loss of all funds because the wallet cannot be accessed anymore, he says.

> *"Questionable parties can't be tracked easily. Another negative aspect is the speculative nature even though it acts as an investment or a financial system. You are dependent on the current market. There is nothing behind the currency like a monetary fund for example who's taking care of the currency. If you lose your password, you can't access your funds anymore."*

For Oliver cryptocurrencies have a bad image because the proof of work validation mechanism is too energy intense compared to payment options like Mastercard.

> *"This costs so much energy, that means it's more expansive than any Mastercard and then it's simply not profitable."*

Multiple participants had a simple trust deficit caused by the complexity of cryptocurrencies. For example, Lisa mentioned her lack of knowledge as a cause for distrust and risk.

> *"I would describe myself as an analog person and I also don't know so much about it, therefore for me the risk is quite high, or you could say my trust in such a digital currency is just too low to take my time to deal with other currencies. Therefore, for me cryptocurrencies are still a book with seven seals."*

Similar to Lisa, Ella said she has less experiences with cryptocurrencies but had a negative impression based on the energy consumption she heard of.

> *"I can't really describe cryptocurrencies, they are some things, which are mined on some computers, which uses unimaginable high amount of electrical energy or used to."*

George had a negative image because he dislikes the idea of cryptocurrencies. For him the centralized part of a currency is helpful to fight criminal activity. He also mentioned the high energy consumption as a big impact on his view of cryptocurrencies.

> *"I see the whole cryptocurrency idea critical, first because it does not have the centralized entity. The centralized entity that stands behind our currency system is not so bad, because for example it helps against criminality. The second reason is the high energy usage without any added value. You are just wasting energy. For the sake of generating money. And I think that concept is flawed because our society works in a way that you use energy to produce something that adds value which you receive something for in return. For that cause we invented currency systems. Because it's easier than always needing to trade something in return."*

On top of that he questions the future proofness of cryptocurrencies. He wonders what happens when mining a cryptocurrency is no longer profitable.

> *"A big problem, which I also see, is, as soon as people say okay it doesn't make sense to mine anymore, the system does not work anymore. It always needs to make sense to mine, and I haven't understood that fully, but there is a limited number of coins that can be mined."*

Only Oliver mentioned that he had had trust in Bitcoin, because it is the best-known cryptocurrency with the highest market capitalization.

> *"Bitcoin. Simply because there is the most money behind it."*

4.5 Brand Image of Gen Digital Incorporated

None of the interviewees had heard of Gen Digital Incorporated, which rebranded just a month before the interviews were held. All interviewees were given an overview of the company's statistics and history as well as the current brands belonging to Gen Digital Incorporated: Norton, Avast, LifeLock, Avira, AVG, ReputationDefender and CCleaner. Almost all interviewees had previous experiences with at least one of the brands from Gen Digital Incorporated.

For example, Paul helped his grandfather who is using Norton on his computer. He mentioned Norton had useful features and a good, structured user interface.

> *"I think my grandfather has Norton and I think it's not bad for people, who aren't too familiar with computers in general. For example, when you plug in a USB stick, and you have Norton installed you can use an automatic checker who's showing up saying*

> *that a new device is plugged in. If you want, you can then check the stick before any access is granted for it. That's not the worst feature and quite interesting and well made. And I also think Norton is well lay out with its user interface."*

Frank made up his opinion completely based on the information he received in the interview. He concluded Gen Digital Incorporated should at least have all the know-how from their acquisitions to produce a good antivirus software, maybe even the best.

> *"In the positive mindset, with all the know-how they acquired with their acquisitions you should think they have very high skills in their company. In terms of antivirus software, you can even assume that they might have the most know-how worldwide which could relate to them even producing the best antivirus software."*

Others held not such a positive opinion of Gen Digital Incorporated based on their business practices. Julia mentioned she does not like companies which are buying up their competitors in order to grow market share and gain know-how. On the other hand, she had positive experiences with one of their products.

> *"I don't like companies which buy up their competition, but their products I trust because I've used Avast in the past."*

Tim and Thomas had a neutral view towards the company, but both highlighted their lack of interest of dedicated antivirus solutions as a factor.

> *"So, I think that they are competent, but I wouldn't get myself software from them. The free versions try to push users to buy with notifications and extra features. There are other ways to create these free services or alternatives which are easier and more comfortable. Because of that I'd avoid such software." – Tim*

> *"Well as I mentioned earlier, I think dedicated antivirus software is annoying for me, like for my specific case because when I was a kid, I just wanted to go on the computer and play video games or do something on the internet and I got always bothered by these antivirus programs because they started automatically and do a virus scan or something like that. And therefore, I would say I don't have a good view about them. But in general, my view towards Gen Digital Incorporated is like neutral." – Thomas*

Oliver had positive opinions towards the brands Norton and Avira and was neutral to the others.

> *"Okay so I say about my opinions towards Norton and Avira or especially towards Norton, because I know them and I use them, positive, towards the other brands neutral."*

So overall the view of Gen Digital Incorporated, a company no one of the participants had known before, was neutral towards positive, based on the established brands and long company history.

4.6 Perception of Ethereum Mining Feature

None of the participants knew about the Ethereum mining feature in the paid versions of Norton360 and Avira Antivirus. Everyone got an overview of the look of the feature with screenshots, introduction on how it works based on the information Gen Digital Incorporated provided to its customers. The feedback was divided into three different perspectives. Some were very positive; some were critical towards the usefulness in form of financial gain and the rest had negative views because of the environmental consequences. Paul for example liked the practical implementation of the wallet.

> *"If I know all this and can work with it, then I don't think this is bad. Yes, in general I think it's cool, especially because you already get a wallet in which you get your coins, very usable."*

Julia also sees it as an interesting and easy way for people who are interested in cryptocurrency mining to get started.

> *"Someone who is interested in it might see it as an interesting and easy way to get into it."*

For Frank the profitability of the feature is questionable but favors the optional approach. He also has environmental concerns.

> *"I think if it's just an option, that's good in general, especially if you want to know more about it and you are using the antivirus software already. In principle for the simple customer, it's a good way to get to know the topic. It has of course also some negative aspects, like the higher energy consumption. Especially these days it's not good etiquette to use more energy. It is a conflict between profit and environment."*

Tim thinks the feature is attractive to users without much knowledge about crypto mining, but questions if there isn’t a way to mine cryptocurrency without paying 15% of the earnings to Gen Digital Incorporated.

> *“Oh interesting! I think for some users it’s definitely attractive who don’t know so much about mining. As far as I know you can also mine yourself without giving 15% away. I also don’t know how well the feature informed you about what happens in the background, but why not?”*

Oliver likes the idea but also showed concerns about the profitability of the feature if 15% go to Gen Digital Incorporated.

> *“Well quite, quite smart idea, but it must be financially profitable otherwise I can just buy crypto coins. I think the dog is buried there because the profit needs to be calculated manually and I would bet you don’t have 15% margin to spare.”*

Anna had some concerns about the aging process of the used hardware but was overall positive towards the idea.

> *“Let me say it like this, if cryptocurrencies are attractive to you in general then this sounds very useful. It’s just one click and you don’t really have any damage besides the energy costs you have even if you don’t use the coins right now. If you are using super much power to mine maybe someday your computer suffers from it, that might be accelerating the aging of it. But yeah, I think that doesn’t sound stupid or dumb, even though I wouldn’t have thought about it because I don’t know so much about it.”*

Thomas viewed the idea as a win-win situation but thinks not every computer is suitable for mining.

> *“You can think about it like a win-win situation. The end user can easily get started with crypto mining just by using their computer and Gen Digital has a huge number of users so they can gather up a lot of money that way. From what I know right now it’s benefitting both parties. Something that you must consider is the efficiency on a laptop or something like that, like something with low power. So, you need a strong computer. You are also depending on the costs of your power and must consider calculating everything through to see if it still makes profit for you with 85% of the earnings.”*

Ella talked about how questionable the energy consumption for such a feature is and that such a feature should only be used with green energy. She doubts people who are interested in cryptocurrency care about that. In a country like Germany, she doesn't see environmentally friendly crypto mining happening.

> *"Okay so I understand the intention and let's say it like this, for some people it's for sure attractive. But energy wise this is really questionable. With the energy economy, as it is right now, this would be only tolerable if you are able to run your pc with green energy only, and for the most of us this isn't doable right now. But likely the people who are interested in it don't care. It's an easy way to get those people who aren't familiar with cryptocurrencies to start with it and an easy way to make money as long as your energy costs are lower than the worth of the cryptocurrency mined. In the current times in Germany, where our energy costs are doubling in 2023, I don't see profitable crypto mining. Especially with the focus on sustainable energy production. If you are able to produce the power sustainably, it's okay, but we are far away from it and the world has enough problems."*

The Ethereum mining feature was received as an easy way to get into cryptocurrency mining. Most concerns were focused on the usefulness, which in this case is the financial gain with the mined Ethereum, with the high energy prices in mind and the 15% cut to Gen Digital Incorporated.

4.7 Brand Image Change of Gen Digital Incorporated

The brand image of Gen Digital Incorporated was for most participants formed about half an hour before they were told about the Ethereum mining feature. The impact of such a feature was for some not immediately noticeable and for others easy to describe.

Paul, Julia, Frank, and Oliver were irritated by the inclusion of a cryptocurrency miner in an antivirus software.

> *"It is a bit strange that an antivirus software producer is doing such a software. What do they have to do with cryptocurrency? It's not about the blockchain and some kind of user data protection with encryption but just mining." – Paul*

> *"I think it's interesting that this kind of feature is added into something that is supposed to be adding security in your computer because I think cryptocurrencies and*

> *mining in general is very shady. If I would mine cryptocurrencies, I would rather want to have a separate program for that." – Julia*

> *"I think the feature is interesting. Right now, I don't see a reason to get or even buy an antivirus software. If I would check specifically software to mine crypto, I think I'd find cheaper or even free software that only does that." – Frank*

> *"I'm a bit split in my opinion. On the one side my curiosity says oh yes cool what is it? On the other side I'm irritated why a cybersecurity company is doing that, they should stick with keeping my pc safe and I'll take care of making money myself." – Oliver*

George and Tim see no real change in their opinions towards Gen Digital Incorporated.

> *"No not really, nothing big changed for me because of it. I guess it would be more likely for me to try it out even though I'm a critic of cryptocurrencies." – George*

> *"Yes, I think it stays the same, I'm not really interested in this feature, but yeah." – Tim*

Lisa's opinion changed to the worse and would reconsider if she'd be in the position to buy herself antivirus software.

> *"I think they are trying out new things and they also have to check that they are staying competitive, but if I would have to make a buying decision, I'd consider that."*

Julia also said her trust lowered because of the shady brand image of cryptocurrencies.

> *"It lowered my trust because I don't know it well and it seems shady to me."*

4.8 Perceived Environmental Impact

The interviewees were given a brief overview of the biggest challenge of proof of work cryptocurrencies – the energy consumption.

Paul said he sees the responsibility with the consumer, because they must make sure they use clean energy for their energy needs. For him this feature has no impact on the sustainability of Gen Digital Incorporated.

> *"With cryptocurrencies I support a system that by itself is damaging the environment. I think during the hype of Bitcoin you could see Bitcoin by its energy consumption as an own country and it was the fourth highest energy consumer, which is absolutely crazy. Gen Digital can't do anything against it, but they are still participating in the system which is very energy consuming. I can make sure, with good consciousness, that the energy that I'm using is not produced with brown coal. For me it matters, unlike for many others, for who this is a big topic, who don't care and it's just about making money. But I think for private people you have influence just by making sure where your energy comes from."*

Tim sees the responsibility solely on Gen Digital Incorporated, but for him it's not changing anything.

> *"In the context of sustainability, I think it would be good that not too many people are mining cryptocurrencies, because it is consuming a lot of electricity. And somehow Gen Digital is responsible. They are profiting that others are using energy. For me that doesn't have a big impact on the view of the company. I think it wouldn't be that dramatic if we wouldn't be in an energy crisis. If we would have renewable energy, then it wouldn't be so problematic."*

Also, Oliver sees the responsibility on both parties, the company, and its users, but it has no impact on his view of the company.

> *"Oh, it's difficult, because if I would have something to say I'd make the companies responsible, but also the private people. Usually, people don't like it, but a company has the higher responsibility for more people and more money on the market, because they are making profits. But in this case also the user is profiting and the one who's profiting should have the higher responsibility. When you are generating money, you should be held responsible for the damages you create. I think often about sustainability, but I never thought about that with antivirus software if I'm honest. Cryptocurrencies are just not efficient, and this is for sure a huge criticism and also you can't really pay for anything with it, which also speaks against it. You could rather just fly to the end of the world with a briefcase full of money and would still be more environmentally friendly than sending bitcoin."*

For Lisa the sustainability factor turned the feature into a genius way to waste energy and get away with it.

> *"I think everybody should, especially right now, check what is using a lot of energy and what is maybe unnecessary. With that in mind mining cryptocurrencies is a bit difficult. I'm not really shocked, because I think many people are doing it and companies always advertise with their sustainability and you give them trust because of that. It is of course a bit strange that if somebody would tell me to let my car run at full throttle all day and in the end, I'll get 100€, that would be quite dumb. I even find it a bit shocking. Yeah, it is a very good concept to earn money and at the same time you can basically wash your hands in innocence, because I can even improve my CO2 statement year by year."*

Anna's reaction leaned more into the whataboutism direction, seeing the feature as not the most immediate place to take action to be more sustainable.

> *"It's maybe difficult to be shooting now just at one company, because there are many, many other companies from any field, which we could easily get rid of with probably even higher energy consumption. But I'm in general thinking you should dispense with not necessary things, and as you might read between the lines, I don't see any added value from cryptocurrencies. I'm sorry for all the people who must work with it, but I think there are way more important points, with which you can save energy or have worse outcomes. I think companies and users should be aware of it. For example, wasting resources. But of course, the companies who offer it have the highest responsibility, but in this case its difficult because more people are involved and somehow everybody is involved, and the company is outsourcing the energy need to some amount. And then there is the question, for example, if they say, how high their CO2 consumption was, are they calculation also the energy the users used to mine? Do they try to compensate these emissions? I think just this feature, me personally, if I think about it, is not so bad, because if there wouldn't be this feature a lot of people would have found another way to invest their energy in it. Maybe I'm the evil one if I say that I don't think it's so bad, but I really think there are more important places, where we waste more resources or energy."*

Frank thinks the feature could be limited but cannot say for sure if Gen Digital Incorporated is accommodating the emissions the feature uses.

> *“I’m still neutral. It’s a medal with two sides. Higher energy consumption is not good, on the other side the economic factor. Maybe they should limit the feature to a certain number of hours on a certain day? We should reduce the energy usage especially during these times instead of increasing them with a feature like this. Maybe they planted a billion trees to accommodate the CO2 their users produced so I don’t know if its greenwashing or not.”*

Thomas’ view was negatively impacted by learning about the sustainability problems of the feature Gen Digital is providing.

> *“Uh yeah, I think it does, especially the point with the energy usage, since we should all be responsible with how we handle our planet. We are already using up too much energy jut because of our daily habits. I can’t get behind any cryptocurrency because of that at the moment. I didn’t know some countries even banned cryptocurrencies. Actually, that’s interesting. And in order to be efficient you have to be doing this all the time and I think it can sort of become an addiction. At some point you know if you are not letting your computer mine you are actively losing money and I don’t think that’s good. So yeah, we should be aware of how much we use, at least to some extent.”*

5 Discussion

5.1 Main Findings

The aim of this study was to find out if including a cryptocurrency mining feature into antivirus software is a good idea from a user's perspective, or to be more precise, if the inclusion has a positive or negative impact on the company and its brands reputation.

From the answers that were given it is clear that antivirus software has been accepted by the interviewees. They mentioned how useful the tool is and how important it is to have. For some the built-in software is so easy to use and has enough features, that they developed negative feelings towards dedicated software that needs to be paid for or include advertisement to be free. One mentioned the political surroundings as a factor which can be neglected in this research. All these aspects go perfectly in line with previous research regarding the technology acceptance model by Davis (1989) and Davis et al. (1989).

Cryptocurrencies are not established yet among the interviewees. In general, the participants' view of cryptocurrencies is very negative. Interviewees mentioned how stressful, complicated, energy wasteful, dangerous, and shady cryptocurrencies seem to them. Most don't understand how the concept works which leads to lower trust. They also have almost no prior experience with using cryptocurrency to pay or trade or mine themselves. Interviewees with cryptocurrency experience had made the experience that it's easily manipulated and dangerous, which pushed them away from further investing time or money into the matter. The brand image of cryptocurrencies in general was very bad, the social image is shady or even criminal, cryptocurrencies don't seem to perform the way they are designed, and trust is nonexistent. Based on these responses it would seem not smart to include a cryptocurrency miner into antivirus software.

Surprisingly the feature itself was received well. The rather business driven responses realized the potential financial gain and favored the optional approach instead of an always-on feature. Four interviewees saw the feature as smart, cool, interesting and as a win-win situation. Only two mentioned the connection of cryptocurrencies' bad reputation as a negative impact on the serious business of antivirus software and the rest only had neutral concerns about the profitability of the feature. It seems that interviewees were overwhelmed by the financial opportunity and neglected all the concerns they have with cryptocurrencies. The brand image and trust towards antivirus software seem to help even further to draw attention away from the bad reputation and lack of understanding of cryptocurrencies. It seems that the mentioned “ease of use” by Davis (1989) and Davis et al. (1989) was the big factor, why the participants did not accept cryptocurrencies in the first place, and the usefulness was rather less important to their opinion forming process.

Gen Digital Incorporated, even though nobody knew the company before the interviews started, received almost completely positive feedback before the participants learned about the cryptocurrency mining feature. Only one interviewee was concerned of the many mergers the company had done previously. As a big cybersecurity company from the USA with brand representation in Germany and Finland, all participants had heard at least of one of the brands Gen Digital Incorporated is offering. As mentioned by Lassar et al. (1995) the five factors responsible for a successful brand image where indeed responsible for the participants reception of Gen Digital Incorporated even though they didn’t knew the companies name beforehand.

A visualization of interviewees’ opinions on antivirus software, cryptocurrencies as well as on Gen Digital Incorporated can be seen in table 2. Opinions about Gen Digital Incorporated have been divided into two stages: first one describes the opinions before finding out about the cryptocurrency mining feature and the second one describes how the interviewees’ opinions of the company changed after finding out about the cryptocurrency mining feature. Interviewees’ opinions are summarized to positive, neutral, or negative on the different topics based on their answers in the interviews. In addition to this, the interviewees’ information on whether they use a dedicated antivirus solution or not is shown as yes or no. This is included in order to understand the relationship the interviewees have with antivirus software producers. Interviewees who are actively using a third-party software have actively decided on a software, while the rest just use what the operating system is offering and have not put as much thought into antivirus software.

Table 2: Interviewees’ opinions

Interviewee	Opinion antivirus software	Dedicated antivirus software user	Opinion cryptocurrencies	View on future of cryptocurrencies	Opinion Gen Digital	Opinion Gen Digital change
Paul	positive	no	negative	negative	positive	better
Frank	positive	no	negative	positive	positive	better
Tim	positive	no	negative	unsure	neutral	neutral
Oliver	positive	yes	negative	negative	positive	better
Lisa	positive	yes	negative	negative	positive	worse

Julia	positive	yes	negative	positive	negative	worse
Anna	positive	yes	negative	positive	neutral	better
Ella	positive	yes	negative	positive	positive	better
Thomas	positive	no	negative	positive	neutral	neutral
George	positive	yes	negative	negative	neutral	neutral

First thing to notice is that interviewees who are not using a dedicated antivirus solution have at least a neutral to positive view of Gen Digital Incorporated after learning about the software feature. Since the feature is optional it seems to increase the amount of features the antivirus software has to offer without any downsides. Only two of the participants who are using dedicated antivirus software see the inclusion as a negative impact on Gen Digital Incorporated's brand image. Half of the participants see Gen Digital Incorporated in a better light than before they learned about the Ethereum mining feature.

In general, with five positive and three neutral changes it seems like a good practice to include a cryptocurrency mining feature in antivirus software, at least, as long as the brand has a good standing, is known and trusted. One of the negative outcomes was already started with distrust in the company which probably, in combination with the negative view on cryptocurrencies, led to a negative view of the feature.

Table 3: Sustainability view

Interviewee	**Who is responsible?**	**Does it matter to you?**
Paul	user	no
Frank	company	no
Tim	company	no
Oliver	user & company	no
Lisa	company	yes
Julia	user & company	yes
Anna	user & company	no
Ella	user	yes
Thomas	user	yes
George	user	no

Table 3 shows how the interviewees see the responsibility of the caused environmental damage by mining cryptocurrency with this feature. The last column highlights whether the environmental impact caused by mining cryptocurrency with this feature matters to them. Surprisingly only two out of all ten interviewees stated that the impact matters to them and the company is responsible. One of them even sees a split responsibility between the company and the user. It seems Gen Digital Incorporated found a perfect way to create a profit without having to take responsibility for the consequences of cryptocurrency mining. All interviewees were told Gen Digital Incorporated has around 500 million users and the energy consumption of cryptocurrency networks are significant, for example the Bitcoin network alone was consuming around 91 terawatt-hours of electricity annually in 2021 (Huang, O'Neill, & Tabuchi, 2021) which is higher than Finland, which used 86,775 terawatt-hours of electricity in 2021 (OSF, 2022). Some of the interviewees knew about the high energy consumption of cryptocurrency mining and were shocked by the high numbers and comparison to whole countries but it did not result in a negative view about Gen Digital Incorporated. The interviewees were suggesting using electricity from renewable sources on the user's side to reduce the environmental impact.

Four of the interviewees see the responsibility solely on the user, which is also surprising, because Gen Digital Incorporated is generating profit with this feature after all. All participants mentioned the current energy crisis as a contributing factor and mentioned how they need to lower their energy consumption. Still, this is not affecting their view about the company's responsibility for their unsustainable cryptocurrency mining operation and most interviewees did not see any problem in Gen Digital Incorporated's cryptocurrency mining business model. Again, they seem to be blinded by the financial opportunity cryptocurrencies are promising and ignore the environmental consequences. It seems the company's image is also not affected from a sustainability perspective. The feature is still perceived favorably by most interviewees.

In an attempt to get the interviewees' outlook on the importance of cryptocurrencies, they were asked to determine the future potential of cryptocurrencies. These answers can be seen also in table 2. Even though not a single person had a positive view of cryptocurrencies, half of the interviewees state that cryptocurrencies will still get more important.

In table 4 the correlation between the interviewees' knowledge about cryptocurrencies and their thoughts about the future of cryptocurrencies are shown. The knowledge was simplified into low, medium, and high based on the interviewees' explanations and experiences about cryptocurrencies. The view of the future of cryptocurrencies was simplified into negative, positive, and unsure. Positive means the interviewee thinks cryptocurrencies are becoming more relevant, negative means less.

Table 4: Interviewees' crypto knowledge and future thoughts

Interviewee	Knowledge about crypto	Future of Crypto
Paul	High	negative
Frank	High	positive
Tim	Low	unsure
Oliver	High	negative
Lisa	Medium	negative
Julia	Low	positive
Anna	Low	positive
Ella	Medium	positive
Thomas	Low	positive
George	Medium	negative

Interestingly, participants with less understanding of cryptocurrencies see them more relevant in the future. This could be media driven and would help to understand why people see value in cryptocurrencies even when they don't understand them. Interviewees with medium or even high knowledge of cryptocurrencies tend to be more negative about the future of cryptocurrencies.

5.2 Limitations of the Study

Considering the novelty of this case, there are issues that could have limited this research. The biggest limitation has to do with the participants. In qualitative research the suitable number of interviewees is changing based on the research type. In this research there were ten interviewees which gave a fairly good understanding of the researched matter, but a bigger group of interviewees would have perhaps given a broader view on the topic. Also, the interviewees were rather homogenic, as they are all from a similar age group and with similar educational background from only two countries.

During the interviews it became clear that most of the interviewees did not have prior knowledge on Gen Digital Incorporated nor about the crypto mining feature in their antivirus programs. Because of this they had to be informed about the company itself and the cryptocurrency mining feature during the interviews. The aim was to be as neutral and unbiased as possible when giving the information, but it cannot be excluded that impressions of the interviewer influenced the interviewees.

6 Conclusion

The aim of this thesis was to examine whether the inclusion of a cryptocurrency miner in antivirus software is a good idea from a user's perspective. The study in this thesis showed that from a user perspective the inclusion has received mostly positive feedback. The most interviewees accepted the feature because it is optional and innovative. It can be concluded that potential customers would be accepting cryptocurrency miners in dedicated antivirus software. The majority had a better view of Gen Digital Incorporated after they learned about the cryptocurrency mining feature, not because of their interest in cryptocurrencies in general, but rather as an easy way for people to get started with cryptocurrencies. The environmental impact of the feature was seen mostly insignificant to the company and the responsibility was seen even split between users and company.

As there was no previous research, the qualitative approach was the most suitable. The approach of semi-structured interviews was well chosen, the resulting conversations were always interesting, and a deeper understanding of the topic could be achieved. The expectation was to see negative impact on the brand image of Gen Digital Incorporated because cryptocurrency mining is very unsustainable, but it was quite the opposite. Even though cryptocurrencies had a bad standing at the start of the interviews, the approach of Gen Digital Incorporated was almost universally appreciated.

For further research it would be recommended that the number of participants would be increased, and the group would be more heterogenous in terms of age, education, and cultural background. Also, people need to be educated about the environmental impact and effectiveness of proof of work cryptocurrencies. The lack of understanding of how ineffective and energy wasteful the process of validation in these currencies is, is astounding.

From this research we can take away that cryptocurrency miner inclusion is from user's side a great idea, but we need laws and institutions that regulate such energy wasteful practices, so companies don't see this approach as a "clean" income source for the future. They are effectively outsourcing environmental responsibility on the cost of the users, and the users are accepting it. With this research a meaningful contribution to the question, how a cryptocurrency miner inclusion in dedicated antivirus software changes the view about the manufacturer, has been added.

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Appendix A: Discussion Guide for Semi-Structured Interviews

Introduction:

1. How are you doing?
2. What kind of education do you have?
3. What is your job position?

Antivirus software:

1. Do you know what antivirus software is?
2. Can you tell me what it is?
3. Which brands do you know?
4. Have you used Antivirus software?
5. Why did you choose this brand?
6. What do you like about the antivirus software you used?
7. What do you think about antivirus software?
    a. Do you trust them?

Blockchain and cryptocurrencies:

1. Do you know what a cryptocurrency is?
2. What are the positive and negative aspects of cryptocurrencies?
3. Which cryptocurrencies do you know?
4. Have you traded or mined cryptocurrencies?
    a. Why have you not?
5. Why did you choose that cryptocurrency?
6. What do you think about cryptocurrencies?
    a. Do you trust them? (FTX crash)
7. What do you think the future holds for cryptocurrencies?

Gen Digital Incorporated:

1. Do you know Gen Digital Inc?
    a. Company exists since 2022 after the merger with AVG
2. Do you know any brands from Gen Digital Inc (Norton, Avira, CCleaner, AVG, Avast, ReputationDefender, LifeLock)
3. Have you used any of the products from these brands?
4. What do you think about the brands?
5. Did you know that Gen Digital had an Ethereum crypto miner in their antivirus software solutions Norton360 and Avira Antivirus?
    a. If no, Norton and Avira had the option since summer 2021 to let the pc mine Ethereum while idling. It's a one click solution, where you activate the mining and can see how long it takes to get a payout based on how fast your computer is. Gen Digital gets a 15% cut of the mined Ether, the 85% that your computer mined was exchangeable via the crypto marketplace www.coinbase.com after you created an account on the website. If the energy your computer used costs less than the market price of the Ether you collected you can make a plus if you trade your Ether instantly after mining

on www.coinbase.com. Alternatively, you can speculate that Ethereum rises in value and keep your Ether. In this case the energy cost of your computer could also be higher than the current value of Ether while you mine Ethereum.

6. What do you think about it?
7. Would you use it? Why?
8. What are your thoughts now about Gen Digital and their brands reputation?

Sustainability and Future:

Given that Cryptocurrencies are highly criticized for their energy usage in an energy crisis and the crash of one of the biggest cryptocurrency marketplaces FTX has reduced the value of cryptocurrencies like Bitcoin to a 2 year low, how would you say the inclusion of an Ethereum miner has:

Affected your view of Gen Digital Inc?

Affected your trust towards cryptocurrencies in general?

Affected your willingness to invest in cryptocurrencies?