

## TRUSTING IN TRUSTLESS TRUST: BLOCKCHAIN INFORMATION STORAGE IN PRODUCT COMMUNICATION

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**Abstract.** *This study reports empirical results of a survey on consumer trust in trustless trust facilities provided by distributed ledger technologies, using the example of an app that obtains product-related information from a blockchain. We report results from 82 respondents who were familiarized with the features of the app under consideration. The novelty of this study is that we provide an assessment of consumers' trust regarding the concept of trustless trust. The relevance for practitioners arises from the abundance of quality certifications, eco-labels and product reviews that add confusion rather than orientation to consumer decision processes at the moment of truth (on- or off-line buying decisions) in combination with the increasing popularity of smart contracts, which can be used to store all the relevant information about product details and processing along the supply chain.*

**Keywords.** *Blockchain; Distributed Ledger Technology; Product Information; Smart Contracts; Trust; Trustless.*

*A lie can travel half way around the world while the truth is putting its shoes on.*

### Introduction

Trust is an underlying determinant that 'participates' in many decisions that managers, employees and consumers make every day. Trust guides both conscious and unconscious choices and can be amplified by digital technologies (Falkenreck & Wagner, 2017). Trust is based on knowledge, using evidence from the past. Contrastingly, faith is based on the complete absence of evidence. The reference to the past explains the power of trust, but also its fragility (Rousseau et al., 1998). When there has been no negative history, no evidence actions, no rumors nor bad experiences, trust is built easily, and people perform more openly. However, such a state of information environment is unlikely (Decker, Scholz & Wagner, 2004; Scholz & Wager, 2006). Worsening the situation, more and more information is produced all over the world, forcing people to cope with a stream of real-time information and huge amounts of data (Ontrup et al., 2009).

Once trust has been broken or even damaged, it is highly difficult, if not impossible, to restore the previous level of trust within same circumstances. Being a powerful motivator, trust is a subject of intense interest to those who need people to make specific decisions. Often information is presented in a subjective way or even misrepresented (Scholz, Meißner & Wagner, 2006). Data manipulation has become a relevant problem

in modern world. For example, a solid proportion of peer-reviewed scientific studies cannot be replicated (Maxwell, Lau & Howard, 2015). The soundness of the information inputted is an important part of the decision-making process and directly influences the quality of the decisions made. The absence of reliable sources of truth and an increasing amount of data require that people spend more time in analyzing the information and making decisions. Unfortunately, time is a limited resource that cannot be produced. In order to make a decision in the same timespan as before, a person needs to handle increased information. People try to involve machines to make calculations and perform tasks involving logical reasoning tasks (Schwerdtfeger & Wagner, 2009).

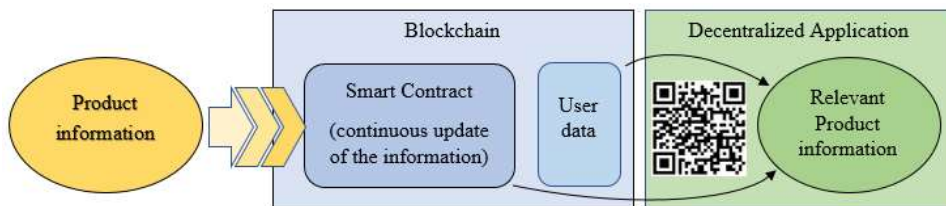
Herein trust is defined as accepting risk in a relationship when there is no reliable information or limited information at all (Büttner & Göritz, 2008). By sharing trust, it is possible for the parties to any relationship to save resources that would be spent on investigation of information. This point is where blockchain technology enters and unfolds its potential for changing the situation. This technology provides a trust surrogate for the parties participating in the system by freezing information and sharing that frozen information (Glaser, 2017). Therefore, it is attractive in the absence of a single source of truth and a lack of reliable sources of information, particularly in cases when suppliers of products use misleading descriptions of product attributes (Amazon, 2018; Online Shopping Rights, 2018). Incorrect information can be intentionally provided or can be a result of an unintentional mistake. In both cases, consumers are at a disadvantage as they are not informed about the true product attributes. Information can be validated by evaluating labels (tags, packaging, manuals, etc.) or considering reviews provided by buyers or users. However, in both situations, consumers cannot be assured of obtaining reliable information. Particularly in online reviews, important details might be omitted to support individual opinions and experiences.

Disputed ledger technologies have the potential to overcome this shortage of reliable information. However, why and when people trust the information in a blockchain must be clarified for it to advance as a problem-solving technology. Despite the years that have already passed from the initial introduction of this technology and the prominence it gained through the Bitcoin hype, it still appears to be in the beginning stage of its life cycle (Gatteschi et al., 2018). Therefore, this study aims to investigate consumer trust and what people think of blockchain technology by using a prototype of distributed ledger-based tool. This prototype aims increase people's trust by retrieving information from the blockchain with a user-friendly interface and, thus, save consumers resources for better purposes. However, blockchain technology cannot assure the user that the information is correct. What can be assured is that the entries, transactions, and changes are consistent as they are decentralized and immutable. If the initial input was wrong and the correctness of the initial data has not been validated, then all further transactions related to this information are also unreliable (Teacy et al., 2006; Jøsang et al. 2007). For those customers who know what a blockchain is and what features this technology provides, the use of a blockchain should not increase trust as the blockchain itself would serve as a database and not a source of truth. On the other hand, for some customers the wording "blockchain technology" could be a sign of trustworthiness and reliability. The worldwide web is not a completely secure place to store information, an issue which has been demonstrated multiple times as instances of data leaks have become widely known. Blockchain is one of the technologies that are able to increase the level of security of the information on the web and return people's trust in the reliability of Internet-based data storage platforms.

The remainder of the paper is structured as follows: In the next section, we outline our research design and the sampling procedure. Subsequently, we describe the data set and outline the results. In last section, we provide a discussion of results and draw our conclusions.

## Research design

In this study, we evaluate a tool that gathers the information about a product into a smart contract and provides this information to the customers. Customers receive only relevant information by applying predefined filters that have been individualized for each customer. The features of the tool are outlined in Figure 1.



**Figure 1.** Product information flow, including the blockchain and decentralized application.

All the processes of each stage of the supply chain are written into this smart contract (Mik, 2017). In this way, all relevant product information is available for end-users. Some actions, according to the logic of the smart contract, trigger other actions. In this proposal, recognition of the product is realized using a QR code recognition system. This technology is widely used nowadays and is becoming more popular with time (Shin et al., 2012; Okazaki et al., 2018; Yang et al., 2017). This system provides several interfaces where information is inputted externally, but, by the system's design, the entire data flow related to a product happens in an automated manner without human interference. Thus, who has added which information when becomes traceable. However, only with the correct initial input can the advantage of the reliable infrastructure (i.e., the source code and hardware) unfold. This infrastructure allows processing and transferring of the information from one state to another without a loss of data or a breach of integrity. However, the interfaces can be considered as weaknesses because, at the input stages, data integrity depends on the participants.

Taking a user perspective, the application substitutes currently existing formats for presenting product information (tags, eco-labels, online reviews, etc.) with ones enriched with the features inherent in blockchain technology. Notably, combining user personal information with product information provides a unique quality of product feature-related information, reflecting the choices of the individual user at each stage of the supply chain schematically (Martens & Maalej, 2018). Figure 2 reflects the information flow process of the application. Simplification of the user interface will provide a better experience and faster acceptance of the tool.



*Figure 2. Schematic representation of the process of user interaction with the product-representing QR code using a personal mobile device.*

Consumer and public policy makers are becoming increasingly concerned about environmental issues, especially in food production and the supply chain (North et al., 2003; Zulauf et al., 2013). Studies across the globe have aimed at deriving information about consumer behavior related to healthy and environmentally friendly products (Chan & Lau, 2002; Thøgersen & Zhou, 2012; Pham et al., 2018; Uddin & Khan, 2018). Results support the idea that younger consumers are more concerned about green products and consume healthier food.

## Data

Information gathered in a trust-related survey is likely to be influenced by biases. Trust is not a binary variable and, in many cases, trust is a derivative of the interaction of other factors. Nevertheless, various studies demonstrate that the results of a survey highly correlate with the results of experiments (Bellemare & Kroeger, 2007; Sapienza et al., 2013; Naef & Schupp, 2009).

This study builds upon an online survey using Google Forms conducted from May 11-17, 2018. Respondents received a link to a questionnaire and were asked to complete it. They had no time limits and could fill in the questionnaire from any device at any time they wished. In total, 82 people participated in the survey. Fifty-six percent of all respondents were male and 44 percent were female. The age of the respondents varied from 20 to 54 years, while the majority (61 percent) represented the age group 25 to 35 years.

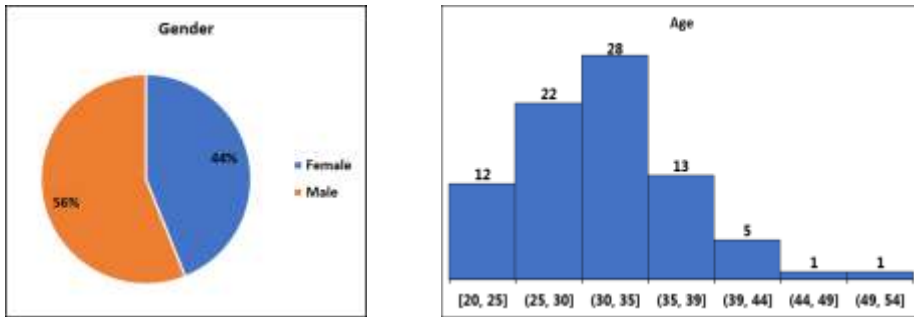


Figure 3. Demographic data of the respondents (gender and age).

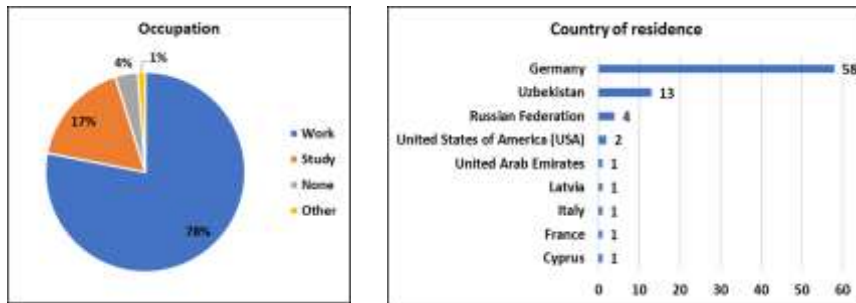


Figure 4. Demographic data of the respondents (main occupation and country of residence).

As can be seen from the data concerning occupation, we gathered a sample of mainly working respondents (78 percent). The other 22 percent were spread between study, no current occupation, and other. Respondents lived in Germany, Uzbekistan, Russia, the United States, the United Arab Emirates, Latvia, Italy, France and Cyprus.

### Results

The first two questions in the second section of the survey asked about the perception of one’s own trustfulness with the question “Can you say that you are a trustful person?” and the respondent’s trust in people surrounding him or her, with the question “Can you say that most people around you are trustworthy?” respectively. Only four people responded negatively to both questions. All the respondents who perceived themselves as not trustful and most of the people surrounding them as untrustworthy did not trust information published through social media, newspapers and TV.

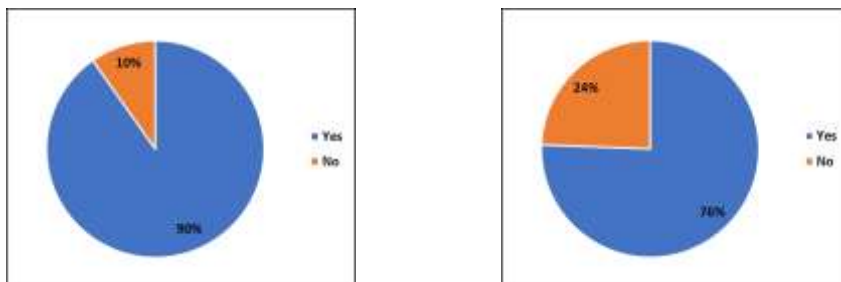


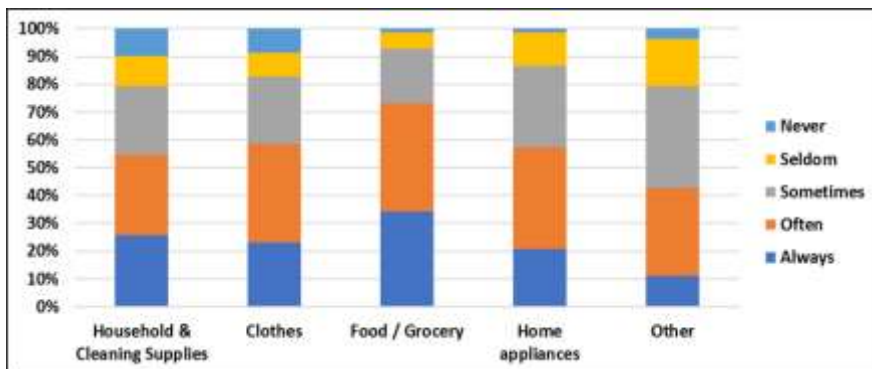
Figure 5. Answers to the questions “Can you say that you are a trustful person?” (left) and “Can you say that most people around you are trustworthy?” (right).

Despite the fact that most respondents perceive themselves as trustful and the surrounding environment as trustworthy, most indicated that they would behave cautiously with new products and new people, with 84 percent being cautious with new products and 79 percent with new people. We conclude that people tend not to trust something that is new to them. This finding is highly important for any innovation or novelty and vital for Internet-based commercial activity.



**Figure 6.** Answers to the questions “Do you agree with the statement ‘When buying a new product (food, clothes, home appliances, etc.), you have to be careful and cautious’” (left) and “Do you agree with the statement ‘When meeting new people, you have to be careful and cautious before trusting them’” (right).

The next set of questions was aimed at testing the extent to which consumers were interested in product description. Consumers products were split into five major groups. Respondents had to measure the frequency of their behavior on a scale from “always” to “never.” As seen from Figure 7, most people cared about information that described foodstuffs. According to the results of the survey, 80 percent of the respondents checked product description at least “sometimes,” which offers motivation to develop a reliable source of information, which will, in turn, be in demand by consumers.



**Figure 7.** Frequency of product description check, by product groups

Most respondents trust information published in the scientific media or information based on research (Figure 8). Eighty-five percent of all respondents indicated that scientific media were trustworthy sources of information for them. Approximately one third of the respondents trusted official statistics from governmental authorities. Newspapers and TV are still trusted by 45 percent of the respondents, while social media proved to be trustworthy sources of information for 21 percent of the

respondents. Those who did not trust scientific sources of information also did not trust the information coming from other channels.

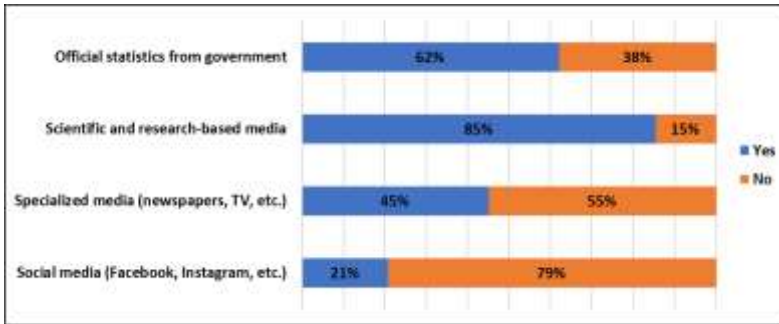


Figure 8. Trust in information by source

Despite the ubiquitous hype surrounding blockchain technology, 24 percent of the respondents had never heard about this technology. Smart contract technology was known by only 38 percent of all respondents. Approximately one half (53 percent) of those who knew about blockchain technology were aware of both technologies.

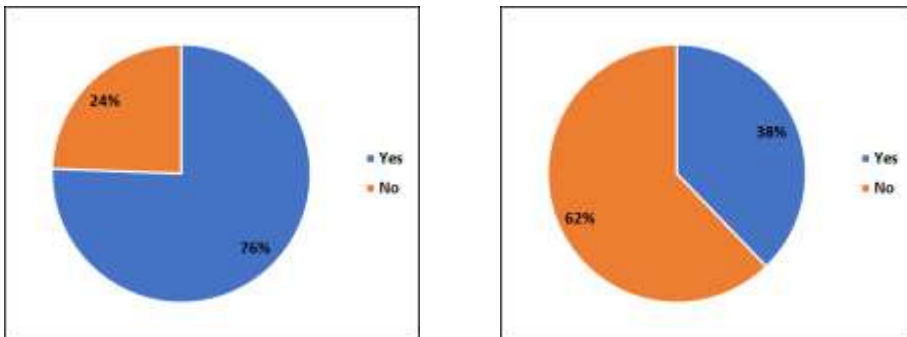


Figure 9. Respondents' awareness of about blockchain technology (left) and smart contracts (right)

The results of the survey correspond to the general statistics collected by Google, which are available online via the Google Trends service (Figure 10).

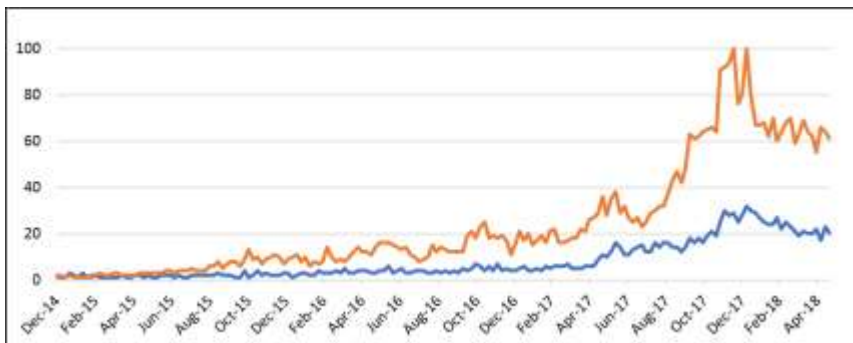
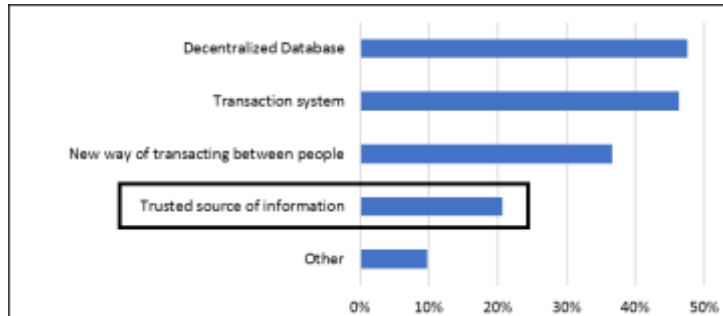


Figure 10. Relative amount of web search requests for 'blockchain technology' (orange line) and 'smart contracts' (blue line) for the past five years. Data source: <https://trends.google.com>

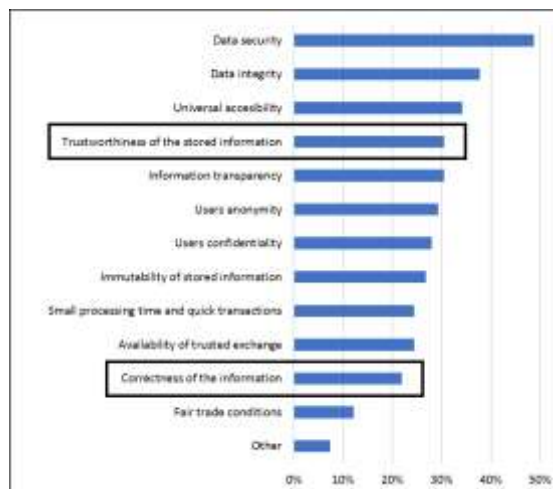
Those who replied affirmatively to the question about awareness of blockchain technology were then asked what the term blockchain technology meant to them and what features belonged to this technology. The highest number of respondents (48 percent) said that a blockchain was a sort of database, namely a decentralized database. The second (46 percent) and the third (37 percent) most popular answers represented a blockchain as a tool for transactions.



**Figure 11.** Proportion of answers to the question ‘What is a blockchain?’

The fourth most popular answer reported that a blockchain was a “trusted source of information.” Only 21 percent of all respondents considered a blockchain to be a source of information that they could trust. This option was included to see if people would ascribe this attribute to blockchain technology. Because of its design, a blockchain, by default, is not a trusted source of information. Erroneous information can appear and circulate in the system. In defining a blockchain as a trusted source of information and by crediting this feature to blockchain technology, people misunderstand the whole structure and purpose of the technology.

In the next question, respondents were asked to select the features that, to their knowledge, are provided by blockchain technology (Figure 12).

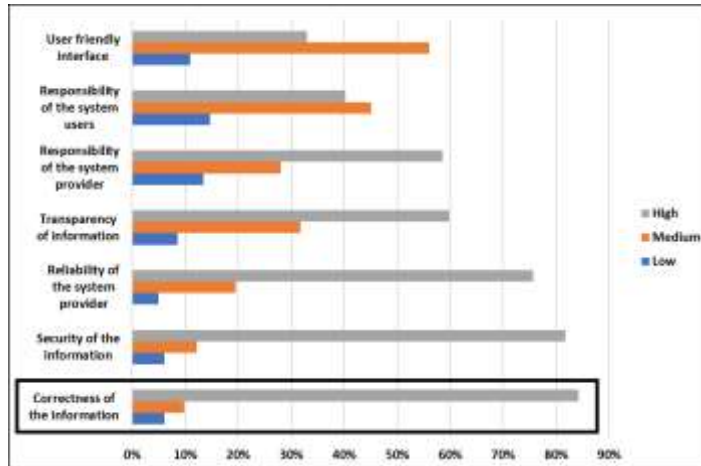


**Figure 12.** Proportion of answers to the question ‘Which features does blockchain technology provide?’



Notably, 30 percent of the respondents chose “trustworthiness of the stored information” as a feature of a blockchain. It can be assumed that, in general, people expect information to be trustworthy. Only 22 percent of the respondents also said that a blockchain provides them with correct information.

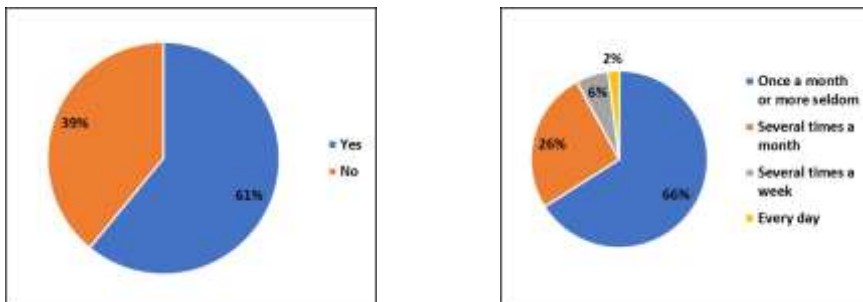
To evaluate the proposition that people value data correctness in digital information storage, the respondents were asked to measure the importance of different features of data storage systems (Figure 13).



**Figure 13. Importance of features of digital information storage systems**

The top three features with the highest ratings were reliability of the service provider, security of the information and correctness of the stored information. The majority of respondents (84 percent) agreed that it is very important to them to have correct information in a database.

Consumers need an easy-to-use interface for obtaining information without going into the details of the blockchain technology. A set of two questions revealed the proportion of the respondents who used the mobile QR code scanner and how often people used that tool. QR codes are popular nowadays and are used for multiple reasons (Soon, 2008). For example, in many Asian countries, such as China, Japan, Korea, and Singapore, QR codes are integrated in digital payment systems and online banking. Approximately two thirds of the respondents have such an application on their mobile devices (Figure 14).



**Figure 14. Proportion of respondents who have a QR code scanner on their mobile device (left) and the frequency of use of the QR code scanner (right).**

## Conclusion

The concept of trustless trust can seem credible using arguments that appeal to technology; however, it needs to be trusted by consumers. This study provides empirical evidence assessing consumers' trust in trustless trust. Notably, trust is perceived differently by people from different cultural groups. Considering the supply chains of consumer goods, particularly fashion or food items, consumers trust is affected by a dominance of unreliable information. A plethora of quality, environmental and working conditions-related labels adds confusion rather than orientation in a situation where a consumer has to choose. Considering this context, an important first result of this study is the finding that consumers report a need for information they can trust. Four out of five respondents reported that they are cautious when dealing with unknown products and persons with whom they are unfamiliar.

Blockchain technology is proposed to be a possible solution to increase trust and decrease the amount of resources spent on monitoring, control, investigations, etc. Blockchain technology enriches a database with features like immutability, integrity, and consistency, thus making the database more reliable and increasing trust in the data contained therein.

The listed features of blockchain technology are known by the specific people who deal with the data storing processes and the technology itself, but, on average, people are not familiar with the technology and especially with the features provided by the technology. Moreover, when it comes to a further development of the blockchain, namely smart contracts, even fewer people are familiar with this technology and know what it means.

For those who are aware of the existence of blockchain technology, the technology is not expected to ensure trustworthy information. The majority of those who know what blockchain technology is understand that there is no such attribute as trustworthiness and that the data in this type of digital storage system, as a result, lack a trustworthiness component.

At the same time, most of the survey's respondents replied that with regard to information storage systems (i.e., databases), the correctness of the stored data is of the highest importance. Combining these two findings, it can be concluded that a blockchain, despite its unique features, cannot serve as a source of a correct information and that many people understand and agree with this statement. Along with correctness of the information, data security was also very important to the respondents. Recent incidents of data breach have informed people that the Internet is not a safe place to store personal data and that there is a need for other solutions to this problem. A blockchain, according to the results of the survey and also information based on research, can be a solution to the problem of data security. Using cryptography and time stamping while storing the data make it hardly possible with current technologies to undermine protection and perform any sort of malicious act with the data stored in the blockchain. As with any technology, a blockchain has weaknesses; nevertheless, the way data is handled within a blockchain database is more secure compared to other existing data storage solutions.

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