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Research Article

Blockchain: Effects in Transactions Costs from Information Governance

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ABSTRACT

This research aims to analyze the effects of the adoption of blockchain on information governance and transaction costs. We present an exploratory, quantitative, and qualitative study. In the first stage, quantitative, a theoretical model was developed and tested based on structural equation modeling (PLS-SEM). Data collection was carried out through an online survey with IT and management professionals involved in blockchain projects from different countries. In the second stage, qualitative, a multiple case study was carried out in order to illustrate how the relations of the developed model are established. In the quantitative phase, the study's hypotheses were supported and it was observed that the adoption of blockchain technology can be seen as a mechanism to reduce transaction costs, since it has a positive impact on information governance. In the qualitative phase, it was observed that, in the three cases analyzed, characteristics such as information security, transparency, and the possibility.

Keywords: blockchain; information governance; transaction costs

JEL Code: M1; O3

INTRODUCTION

Blockchain technology emerged in 2008, from the development of a solution to eliminate the intermediary in financial transactions, which is currently recognized as the Bitcoin cryptocurrency (Nakamoto, 2008). In this way, far beyond the cryptocurrency itself and the solution to the intermediary's problem, a new type of distributed database was developed called blockchain, in which transactions are securely included, permanently, using cryptography (Atzori, 2015; Lucena, Binotto, Momo, & Kim, 2018; Wright & Filippi, 2015). With this new technology, characteristics such as the disintermediation of transactions and the security in the bookkeeping of transactions allow organizations that provide a certain service or product — based on a relationship of trust between buyer and seller — to be susceptible to the impact created by blockchain on business. This effect occurs not only because of the market disruption, but also because it offers new opportunities to create value in an appropriate business model to exploit this technology (Cohen, Amorós, & Lundy, 2017). Considering its specific characteristics that differentiate such technology from existing ones and by having great application possibility and influence in business, one can observe an increase in academy interest for this new technology.

When looking at the area of applied social sciences, it is clear that the main topics addressed are: regulation of this technology for greater impact and corporate use; use of blockchain technology as a record base that can assist in the development of sharing services (shared economy); study of blockchain and its effectiveness in relation to the issue of fraud in the context of online transactions; and motivations of the banking sector for implementing blockchain strategies (Cai & Zhu, 2016; Guo & Liang, 2016; Lemieux, 2016; Sun, Yan, & Zhang, 2016; Wang, Chen, & Xu, 2016; Yeoh, 2017; Zhu & Zhou, 2016). Thus, it is clear that most of the debates developed in studies focus on the benefits and challenges of possible scenarios for the adoption and use of this technology, requiring "a comprehensive understanding of the terms of application and use cases" (Risius & Spohrer, 2017, p. 390). In such a way, in order to move forward with its dissemination, "research should investigate the costs and benefits of blockchain, and not just focus on improving ease of use" (Risius & Spohrer, 2017, p. 401). Another gap highlighted in the literature on this topic is that there are only few studies and contributions about the disruptive potential of blockchain technology that cross the domains of IT (Beck & Müller-Bloch, 2017) and focus on a broader approach in organizations.

It is understood to be relevant to explore the impact of using blockchain on business, considering the consequences that its use can bring to contemporary business processes and models (Avital, Beck, King, Rossi, & Teigland, 2016; Beck, Czepluch, Lollike, & Malone, 2016; Lindman, Rossi, and Tuunainen 2017). Moreover, as "most existing research focuses on platform resources and use cases, there is a real need for the [information systems] field to address the social implications of technology and the changes brought about by use cases for business models" in which blockchain is used (Beck, Avital, Rossi, & Thatcher, 2017, p. 383).

In order to explore this theme and the consequences of its use from an organizational perspective, this study proposes a discussion between blockchain and two theoretical approaches: transaction cost theory (TCT) and information governance (IG). In the TCT, the reason why organizations exist is discussed, which, for Coase (1937), occurs because the costs of managing economic transactions outside organizational limits are higher than those managed within. In addition, some behavioral assumptions and critical dimensions mediate the choice of the organization in producing inside or outside its limits, as a solution to deal with questions such as the uncertainty that the economic actors face to carry out transactions (Williamson, 1985). For this reason, it is necessary to understand the influence of using blockchain to minimize costs in economic transactions outside the limits of the organization.

The information governance (IG) has as its objective to guarantee the "accuracy, integrity, accessibility, and security" of the information, and, to achieve this, it is necessary for a company to have "[specific] structures and processes to manage the total life cycle of the information" (Earley, 2016, p. 17). When an organization seeks to carry out the core activity of the IG, it must address different domains in the information systems (IS) field, such as: information security; and quality of information and privacy, considering their policies, procedures, and technologies (Brown & Toze, 2017; Khatri & Brown, 2010; Young & McConkey, 2012). For this reason, it is essential to be aware of the influence concerning the use of blockchain in the face of IG.

Considering the relations shown between blockchain and the two theoretical approaches presented (TCT and IG), and in order to give greater attention to the impacts that this technology can cause to business, the present research aimed at analyzing the effects of adopting the blockchain in information governance and in transaction cost.

It is noteworthy that it is expected to contribute with what was highlighted by Risius and Spohrer (2017), who suggest investigating the costs and benefits of blockchain, bringing in the perspective of transactional costs in economic exchange relationships. Still, Rasouli, Eshuis, Grefen, Trienekens, and Kusters (2017) highlight the information as being an important resource to the organization, requiring mechanisms to support the quality and to protect the information from opportunistic behaviors. Therefore, we seek to present how the adoption of blockchain can influence the theoretical construct of information governance and transaction cost in order to facilitate economic exchanges, while its adoption would imply an improvement in the protection and quality of information.

PROPOSED MODEL

This section presents the concepts and characteristics of blockchain alongside with the transaction cost theory and with the information governance, which assist the proposing model to be tested.

Blockchain and transaction cost theory

As Tapscott and Tapscott (2017) explained, it is believed that, by having a potential to transform the way businesses are organized and managed, blockchain will allow the minimization of transaction costs and the use of resources outside the firm as easily as using resources within the firm. (Tapscott & Tapscott, 2017). In fact, Tapscott and Tapscott (2017) claim that transaction costs will be 'eliminated' (and not minimized). However, only a technology such as blockchain would be unable to deal with all the complexity of factors that would 'eliminate' or cause transaction costs to cease to exist altogether. In any case, the minimization or elimination of transaction costs occurs in this idea, since the principles of blockchain would allow to mitigate the effect of bounded rationality and opportunism, as well as modify the way in which transactions operate (influencing the critical dimensions of transactions).

The existence of behavioral assumptions in the transaction cost theory (TCT) exposes the relevance of the firm's presence, given that, if these did not exist, the transactions could all be carried out in the market (Coase, 1937). In an economic transaction, there are always, at least, two economic agents/actors who can behave during this transaction, in view of TCT's behavioral assumptions, with bounded rationality and opportunism. Bounded rationality is understood as a human condition related to cognitive limitations (Simon, 1978). In regard to transactions, this condition does not allow all variables to be mapped in the existence of contracts with unlimited complexity, that is, it is not possible to predict all situations that could affect the contract in the face of uncertainty (Barney & Hesterly, 2004; Williamson, 1975; 1985). It is emphasized that the use of blockchain would not necessarily decrease this human cognitive limit, considering that this technology does not intend to directly assist the decision-making, but to provide a more reliable way of transacting without needing an intermediary (Nakamoto, 2008).

With regard to opportunism, it reinforces the need for formal bookkeeping of transactions, because, due to its existence, the execution of informal contracts becomes fragile (Barney & Hesterly, 2004). Opportunism is related to information asymmetry and its use to achieve an advantage (Williamson, 1985). It is reinforced that the use of blockchain, as in the case of bounded rationality, would not act directly to reduce the use of information asymmetry in the negotiation of a contract in order to obtain any advantage, but would help the bookkeeping of transactions, just as a contract, would be safe and immutable (Jeppsson & Olsson, 2017; Nakamoto, 2008; Tsai, Blower, Zhu, & Yu, 2016; Tschorsch & Scheuermann, 2016; Yli-Huumo, Ko, Choi, Park, & Smolander, 2016). Therefore, in relation to behavioral assumptions, the use of blockchain would have an indirect influence.

With respect to the critical dimensions to transcribe the transactions (uncertainty, frequency, and asset specificity), only two dimensions (uncertainty and asset specificity) are focused to describe the possible effect that the use of blockchain would have in these dimensions. This is because, according to many authors, frequency is totally related to two other dimensions, without needing to be mentioned separately (Barney & Hesterly, 2004; Fiani, 2013; Liang & Huang, 1998).

Uncertainty is the dimension related to information asymmetry, and contracts are the way in which organizations try to minimize this factor that may be related to inputs for the transaction, with final products or with behavioral factors (Bao & Wang, 2012; Faria, Arruda, Di Serio, & Pereira, 2014). Blockchain could, in this case, act to expand the possibilities of making more secure and complex contracts, since its principles make it possible to guarantee "trust in transactions and much recorded information no matter how the other party acts" (Tapscott & Tapscott, 2016, p. 33).

Asset specificity refers to those transactions in which there is a reduction in supplier alternatives due to the specificity of what is sought, opening up a greater possibility for opportunism (Grover & Malhotra, 2003). In this sense, the application of blockchain is highlighted for the cases of specific assets that require greater tracking and registration of their specificities during the process, which could generate more confidence in carrying out transactions with this type of asset among economic actors, such as in grain exports (Lucena et al., 2018).

Still, with the proviso that the blockchain guarantees the quality of the product and the process with a reliable and immutable bookkeeping (especially for its characteristics of distributed power and security), the risk of opportunism can be reduced, since it is not necessary to restrict the supply of that asset to an initially known supplier. Additionally, due to the inclusion characteristic, it is now possible to consider everyone who has the registration of their processes and assets on the blockchain. And the other characteristics of blockchain (value as incentive, privacy and rights preserved) (Tapscott & Tapscott, 2016) help, even if indirectly, to build this safe bookkeeping.

In view of these considerations, it is understood that blockchain has a negative effect on transaction cost, that is, its use helps reduce transaction costs in order to facilitate economic exchanges outside the organization's limits with confidence and without the need for an intermediary. Thus, it seeks to prove that the use of blockchain can be a mechanism to minimize these costs and presents itself as an efficient model for structuring and protecting data.

Blockchain and information governance

The information governance (IG) has as its objective to guarantee the "accuracy, integrity, accessibility, and security" of the information, and, to achieve this, it is necessary for a company to have "[specific] structures and processes to manage the total life cycle of the information" (Earley, 2016, p. 17). Considering the concept of information governance and its relevance to the current context of the market, as well as the functioning structure of the blockchain, it can be understood that its use is positively related to that one. Figure 1 presents the concepts that are part of information governance that will be used as a basis for reflection on blockchain and IG.

Concepts	Description	Reference
Accountability	Accountability is the connection of two components: the ability to know what an actor is doing and the ability to make that actor do something else	(Schedler, 1999; Hale, 2008)
Accessibility	Accessibility means that information is able to be found and presented to the person who needs it, when needed, as well as in the appropriate form.	(Martin, Dmitriev, & Akeroyd, 2010)
Sharing	Sharing is the free exchange of non-confidential and sensitive information. It occurs between individuals in teams, across functional and organizational boundaries.	(Marchand, Kettinger, & Rollins, 2000)
Compliance (Compliance; Privacy; Retention; Ethics)	Compliance is the duty to comply with and enforce internal and external regulations imposed on the institution's activities.	(Associação Brasileira de Bancos Internacionais [ABBI], 2009)
Communication (Communication; Transparency)	It refers to transferability (signals) and the transfer mechanisms between individuals, across space and over time.	(Grant, 1996)
Monitoring	Monitoring is done to increase the amount of information available to shareholders and can alleviate agency problems when insider ownership is low.	(Anderson, Melanson, & Maly, 2007; Becher & Frye, 2011)
Standardization	Metadata or data about data is information DNA. Consistency here will pay dividends and make Compliance and auditing more efficient and less "painful". By standardizing foundational components, you become more agile	(Samuelson, 2010)

Figure 1. Concepts that are part of information governance.

Note. Adapted from Faria (2013).

Model and hypotheses

In view of what has been presented, it is identified that blockchain tends to assist in information governance, especially with regard to transactional information. Additionally, it can be seen as a technology that facilitates economic exchanges outside organizational limits, and can be understood as a governance mechanism that minimizes transaction cost. Figure 2 presents the theoretical model and its hypotheses.

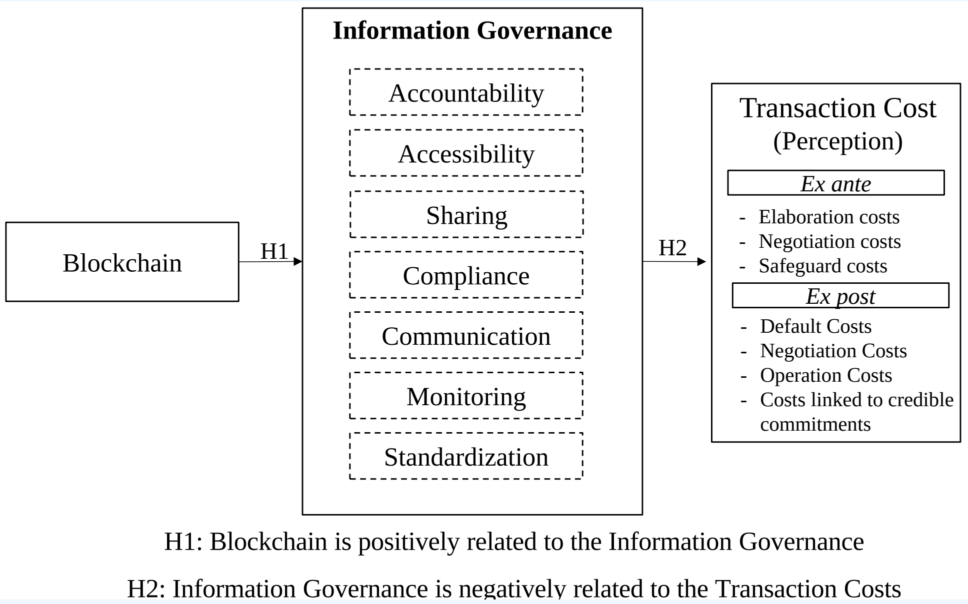

Figure 2. Research model.

Regarding the relationship between governance and the transaction cost theory, Williamson (1975) highlights that, in the transaction cost theory, governance structures are mechanisms to which organizations resort, in order to reduce transactional problems caused by bounded rationality and opportunism. Consequently, "economic actors will choose the form of governance or governance structure that reduces any potential exchange problems at the lowest cost" (Barney & Hesterly, 2004, p. 135). For that reason, the objective of analyzing elements that impact transaction costs is to define a better governance structure for the firm. As a result, the model does not have a direct relationship between blockchain and transaction costs, because in the TCT the governance structures are the ones that can alter transaction costs, which justifies the model's constructs.

More specifically about information governance, even though this is a more contemporary concept, Williamson (1979) already highlighted efficient information processing as an important concept and that, in this context, governance structures that would mitigate opportunism would be necessary. Therefore, it is possible to understand that an information governance structure can assist in this efficient information processing and mitigate behavioral assumptions, which are: opportunism and bounded rationality, with regard to uncertainty, in view of the information asymmetry.

It is understood that the person responsible for impacting transaction costs is the governance structure defined by the firm, and the efficient information processing, in other words, information governance, can mitigate behavioral assumptions and thus also impact on transaction costs. In addition, due to the characteristic of blockchain being a database, with more or less flexible requirements, this technology defines "structure and process to manage the total life cycle of information and maintain the governance valid throughout the time" aiming to guarantee "accuracy, integrity, accessibility, and security," these being the objectives of information governance (Earley, 2016, p. 17).

Consequently, blockchain presents itself as a technology that structures information related to economic exchanges and has 'information governance,' that is, its own structure and process to manage the information lifecycle. In this case, it is understood that the blockchain is not, in its entirety, the informational governance structure of an organization. However, it has an informational governance structure that must be adopted by the firm that chooses to use this technology to record its transactions.

METHOD

This study is characterized as an exploratory research, carried out in two stages: quantitative and qualitative, according to the following research design:

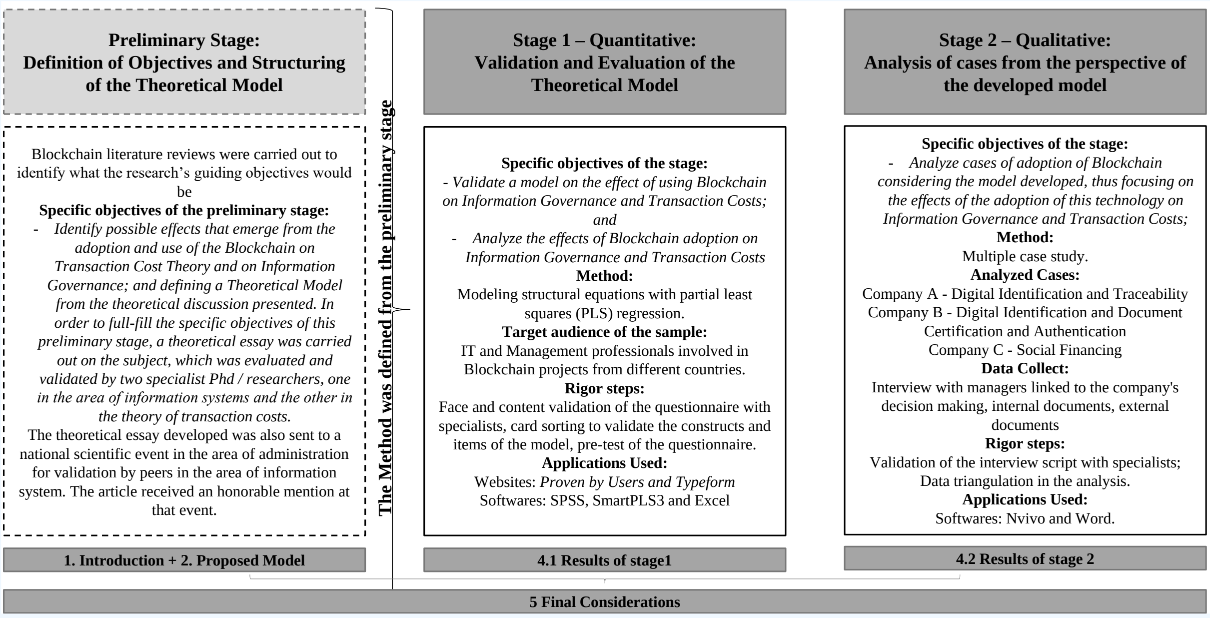

Figure 3. Research design.

Stage 1 — Quantitative

In this stage, a survey was carried out in order to enable, from the exploratory approach, a greater understanding of which concepts should be measured and how to measure them, in addition to providing a greater evolution of the theme (Lakatos & Marconi, 2010). The target population of the survey were professionals involved in projects related to the use of blockchain technology. The focus of the composition of the sample was: managers, coordinators, and project participants, who have knowledge of blockchain's business and programming or technological structure, as it aimed to highlight the effects of using blockchain on transaction costs. For this, the respondents needed to understand both the technology and its very specific structure, as well as the business processes and their modifications with the use of this technology in the processing of transactions. Due to these specificities regarding the respondents, the study samples (pretest and complete study) were not probabilistic, but for convenience, in order to obtain a logical sampling unit for the purpose of this study (Hair, Black, Babin, & Anderson, 2014).

For pretest, specialists/technicians with knowledge related to information systems management and who had knowledge about blockchain technology were selected. For the application of the full study, respondents from companies that are involved with the adoption or deployment/development of blockchain were selected. To achieve this, from a study carried out with the Crunchbase[1] database (Momo, Schiavi, Behr, & Lucena, 2019), 810 active companies — excluding companies that were no longer active — that contained in their description the word 'blockchain' were identified and an initial list of organizations that have professionals who meet the expectations of the sample of this study was obtained. From this initial list of 810 companies, 432 company email addresses were obtained. Of these 432 email contacts, when sending the message, 37 emails were obtained that returned stating that the address was non-existent. Therefore, 395 emails were effectively sent to different companies containing the online questionnaire in

English. It is noteworthy that most companies on the initial list are technology companies that provide solutions to different companies from different economic areas, thus the larger number of respondents from this type of company (IT and software) is expected since other sectors are investing in this technology through these companies.

To estimate the size of the minimum sample, the G*Power 3.1 software was used to calculate the minimum sample, evaluating the number of predictors of the dependent variable, the power of the test and the size of the effect (f2). In the model of this study, there is a predictor and, regarding the other parameters, the recommendations of Hair, Sarstedt, Hopkins, and Kuppelwieser (2014) were followed in order to use 0.80 as test power and 0.15 for the effect size (f2). With this information, a minimum sample reported by the software of 55 respondents was obtained.

The data collection instrument from the survey was developed from a sequence of steps that sought the instrument's quality requirements, in terms of both content and form. We chose the questions of agreement to capture the perception of those involved in blockchain projects, from a Likert scale of seven points (Engel & Schutt, 2013). Regarding its structure, it is noteworthy that there were 12 initial questions to identify the respondent's profile and their knowledge about blockchain technology; 14 items on blockchain that addressed features of networked integrity technology, distributed power, value as incentive, security, privacy, rights preserved, and inclusion, features initially categorized by Tapscott and Tapscott (2017); 14 information governance items based on the concepts explored in Table 1; and seven items about the transaction cost construct that had as its initial basis the transaction cost categories highlighted by Williamson (1985): contract drafting cost, contract negotiation cost, safeguarding costs, default costs, negotiation costs, operating costs, and costs linked to credible commitments.

The instrument initially elaborated was submitted to face and content validation to evaluate, respectively, when one of the concepts addressed is obviously more pertinent to the meaning of one concept than to the meaning of another concept; and the degree to which a measure encompasses the meanings included in the concept (Babbie, 1999; Hair, Babin, Money, Samouel, & Ribeiro, 2005). To perform these validations, we had academics and practitioners with experience in the area of systems management and information technology. The document has been updated, incorporating some suggestions for improvement regarding the terms used and the clarity of some issues.

The card sorting technique was also applied with the categories previously defined in the model to validate the constructs and items of the model. For this stage, the participants were three students (doctoral students) in the area of information system management with previous knowledge on the themes of this study. During this stage, the website *Proven by Users* (https://www.provenbyusers.com/ retrieved on October 11, 2021) was used, in which you can perform the card sorting free of charge for up to three participants. For the operationalization of this technique, the constructs and items were shuffled so that the participants could associate the items with their respective constructs, according to their views and experience. Thus, regarding the application performed, it was observed that the accuracy percentages were relatively high, higher than 70% for all participants, which attested the existence of adequacy of the items in the questionnaire to their respective factors. The factors with the highest levels of errors by respondents were blockchain and information governance (IG), in which there was the exchange of one factor for another, which is expected and is justified by the fact that blockchain is brought in this study as a possible IG mechanism. It is noteworthy that the errors were analyzed and, when necessary, small adjustments were made in the writing of the item. After these steps, the questionnaire was obtained in its final version for the pretest.

The pretest of the data collection instrument (questionnaire) consists of the application of this instrument with a small sample, allowing the researcher to identify and eliminate potential problems during the application of the instrument and to define an average time necessary to answer it (Cooper & Schindler, 2003; Malhotra, 2012). The pretest was carried out with specialists/technicians in systems management and information technology. After the application of the pretest of the data collection instrument and its analysis, a final revision of the wording of the questionnaire items was carried out based on the results obtained. It is noteworthy that this final questionnaire (Appendix A) also underwent validation by the three specialists who evaluated this instrument previously.

The data collection of this research was carried out by means of an online survey, with the help of the Typeform software, with IT and management professionals involved in blockchain projects. Accordingly, in August 2019, 395 emails were sent. In addition to the emails, in view of the low adherence in the first two weeks, it was decided to call (utilizing the Skype system) the companies located in Europe and North America that had the number available on Crunchbase. Therefore, based on these two strategies (email and call), at the end of the month, 71 answered questionnaires were obtained.

An analysis was performed to identify possible outliers, for which the exclusion of questionnaires that had all the answers in the same item or where the respondents used 90% or more of the answers in just two scales was used as a parameter. When using these criteria, no questionnaire was excluded. As an additional precept, questionnaires were excluded from the sample in which the respondent considered his knowledge of Blockchain less than four points on a seven-point scale. In this case, only one respondent who checked level 2 on the scale was identified and, therefore, excluded. In total, only one questionnaire was deleted, leaving 70 valid questionnaires for study.

Data analysis was initially performed using statistical techniques. The data obtained with the survey application were tabulated in a spreadsheet and later analyzed with the aid of two software: SPSS and SmartPLS 3. The analyses performed with the aid of SPSS are the reliability, descriptive, and exploratory statistics analyses of the data. After performing these initial analyses, for the model test and hypothesis test, structural equation modeling with partial least squares (PLS) of regression was used, utilizing the SmartPLS 3 software. Regarding the appropriation of PLS for this study, it is noteworthy that PLS-SEM (partial least squares – structural equation modeling) is appropriate when the objective of the research is the prediction and development of theory (Hair, Ringle, & Sarstedt, 2011). This research focuses on exploring and predicting factors that lead to minimizing transaction costs from the use of blockchain technology.

Stage 2 – Qualitative

At this stage, a qualitative study was carried out, aiming to illustrate the evidence found in the quantitative phase. The choice for the development of this stage was due to the fact that a mixed method approach "is potentially superior to a single method design, because it can provide valuable information about phenomena and develop new theoretical explanations" (Kim, Kankanhalli, & Lee, 2016, p. 728). That said, the choice to elaborate this stage seeks to enhance the insights and improve/develop new theoretical perspectives on the themes in this study from the cumulative nature of this strategy used (Venkatesh, Brown, & Bala, 2013). Regarding the way this stage of the research is operationalized, it was decided to conduct a holistic multiple-case study in three companies that have as a value proposition the delivery of solutions to customers using blockchain technology (Yin, 2015). Appendix E presents the focused companies profile of the case studies and a summary on the type of data collected and the data analysis technique used.

The definition of approach as multiple cases is due to the fact that the contextual conditions of three companies will be analyzed (Yin, 2015). Regarding the framing of the research as a holistic case study, this occurs to the extent that only one unit of analysis will be analyzed in each of these three organizations, and not diverse, as in the integrated multiple case study (Yin, 2015). The choice to carry out this type of study (holistic multiple case study) is due to the need to obtain a more in-depth perspective on the issue, which is related to a contemporary phenomenon, blockchain technology (Yin, 2015).

For data collection, two techniques were used: semi-structured interview and document collection (primary and secondary documents). Regarding the subjects and the objectives related to each collection technique, in the semi-structured interviews, managers of the companies were interviewed in order to guarantee the collection of the perception of people linked to decision-making in the organization. Furthermore, the choice of the interviewees took into account the maturity of these agents and technical knowledge about the technology and its application. Therefore, it was decided not to interview clients of these companies that use blockchain technology from an interface, that is, they know the benefits, but they do not necessarily know how these benefits are generated/achieved.

The semi-structured interview for these subjects was centered on the identification of benefits, challenges, and costs of the adoption of blockchain, in view of information governance and transaction cost (Appendix B). The interview script was structured from the literature review and the questionnaire used for the quantitative part of this thesis. Regarding the validation of this script, it is noteworthy that it was analyzed by three specialists in systems management and information technology who validated this data collection instrument. The profile of the professionals interviewed in the three case studies carried out is presented below.

Case	Name used in the article	Position	Gender	Age
Company A	Respondent 1	Trade Manager	Female	34 years old
	Respondent 2	Marketing Manager	Male	23 years old
	Respondent 3	Financial Manager	Female	26 years old
Company B	Respondent 4	Owner/Manager	Male	40 years old
Company C	Respondent 5	Project Director	Female	32 years old

Figure 4. Details of respondents in the three case studies carried out.

Regarding documentary collection, two types of documents were collected: primary and secondary (Marconi & Lakatos, 2010). Thus, for this collection, the organization's internal documents given during interviews, documents on the website of the studied company, and posts made on Facebook and Instagram until July 2019 were considered. In order to make explicit the data carried out in the three case studies, the Appendix E, which summarizes the performed procedures, is presented.

It is noteworthy that all data collection for this qualitative part occurred in August 2019 and that all interviews were recorded and later transcribed by the researchers. The various data collection strategies aimed to allow the data triangulation (Flick, 2009). Regarding the data analysis procedures in this qualitative phase, we opted for the use of content analysis (Bardin, 2011) with hierarchical codification, since we sought to carry out a systematic analysis process to identify the characteristics of the information present in the collected textual elements (Hair et al., 2005). All collected data were saved in a text document or in PDF files for analysis with the Nvivo12 software.

Concerning the initial categories that will guide the content analysis, two constructs of the model of this research stand out: information governance and transaction cost. The choice for these two initial categories has to do with the objective of this stage, which is to analyze the effects of the adoption of blockchain on information governance and transaction cost. The coding framework used for data analysis was constructed according to the proposal of Macqueen, McLellan, Kay, and Milstein (1998) (Appendix C). It is noteworthy that the other categories of content analysis, intermediate and final, were *data driven*.

PRESENTATION OF RESULTS

Stage 1 results

Initially, the characteristics of the respondents and their respective organizations were verified.

Age	Number of respondents	Sector of work	Number of respondents	How long works with Blockchain	Number of respondents
24-25	7	Administrative	3		
26-30	26	Financial	5	Until 1 year	21
31-35	20	Information Technology	59	Until 2 year	21
36-40	9	Research and Development	3	Until 3 year	13
41-45	5	**Years of Service in the Company**	**Number of respondents**	Until 4 year	8
46-50	0	until 2 years	44	Until 5 year	5
51-55	1	3-4 years	19	Until 6 year	1
56-60	2	5-6 years	7	Until 7 year	1

Company Size	Number of Companies	Year of foundation of the Company	Number of Companies
Small (until 10 employees)	31		
Medium (11-50 employees)	33		
Large (51+ employees)	6	2000-2008	6
Company Field	**Number of Companies**	2009-2012	4
Financial sector	31	2013	6
Health Sector	6	2014	22
Education Sector	1	2015	17
Software and IT	28	2016	11
Media and Entertainment	4	2017-2018	4

Figure 5. Characterization of respondents and companies.

In relation to the respondents, it is noteworthy that the majority is between 26 and 35 years old, being in the company, mostly, up to two years. It is observed that 84% of respondents work in the information technology (IT) sector and the majority have worked with blockchain for up to three years. With regard to the companies of these respondents, it is identified that most of them work in small and medium-sized companies in the financial sector or software and IT. Still, in relation to the year of foundation of the companies, it is noted that the majority started their activities in 2014 and 2015.

Seeking to provide greater knowledge of the database of responses, descriptive statistics analyses were performed. Among the information analyzed, the average (measure of central tendency) and standard deviation (measure of dispersion) stand out, values presented in Appendix D.

It was possible to verify that blockchain was the factor with the highest average among the constructs of the model (5.47). Analyzing the items of this factor, it is noted that the two items with the highest average were: BC1 (6.04), related to the networked integrity characteristic; and BC3 (5.86), related to the distributed power characteristic. The results suggest that these are some of the main elements, according to respondents, that corroborate the characterization of blockchain. The factor with the lowest average was information governance (4.75). In general, it is noticed that all factors have a relatively high average, since it exceeds the midpoint of the scale.

After the descriptive analysis of the data, the reliability study of the instrument and its factors was performed, using the Cronbach's alpha coefficient, by which the internal consistency of the instrument was measured. It should be noted that the Cronbach's alpha value of the factors and the model (Appendix D) was higher than the minimum value of 0.70 (Hair, Black, et al., 2014).

Exploratory factor analysis (EFA) was also performed to analyze the unidimensionality within the set of items for each factor (Hair, Black, et al., 2014). Before the performance of the EFA, the adequacy of the data was verified based on the tests: Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity (Appendix D). Values above 0.5 were obtained in the KMO test, indicating that the factor analysis is acceptable. And in Bartlett's test of sphericity, it was identified that the sample is significant because it has a p-value below 0.05 (Hair, Anderson, & Tatham, 1987). With these results, exploratory factor analysis was performed on the blocks (Appendix D), to assess whether the minimum value of the items was 0.40 (Koufteros, 1999; Lewis & Byrd, 2003).

It was found that the factor loading values obtained by the EFA are greater than the minimum value of 0.40 for most items in the model. Items that presented values below the minimum (BC2; BC3; GI1; GI2; GI3; GI8; CT3; and CT4) were excluded in the following analyses, in view of the fact that their factor loadings are below the minimum level of 0.4.

As a result of these preliminary analyses, the evaluation of the measurement models and structural model was carried out. The results obtained are highlighted in the Figure 6 below.

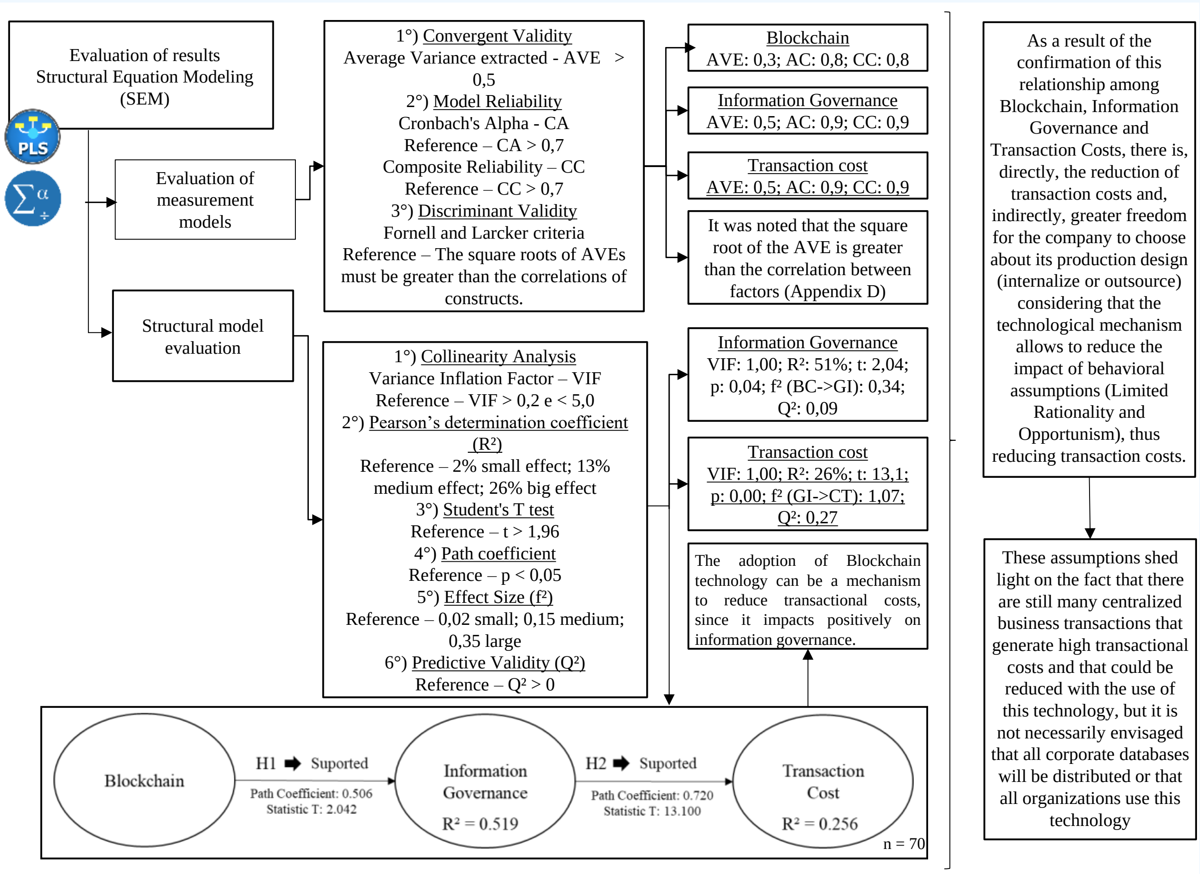

Figure 6. Summary of structural equation modeling results.

Measurement model

In the evaluation of the measurement model, the reliability and validity of the measurement model are analyzed. This assessment used the criteria described by Hair, Ringle, and Sarstedt (2011), which are: individual outer loadings of the research items; composite reliability (CR); convergent validity (average variance extracted — AVE); and discriminant validity (Fornell-Larcker criterion) (Appendix D).

The reliability of the items was carried out based on the analysis of the factor loadings, which should be close to 0.7, as recommended by Hair et al. (2011). However, eight values were found below 0.6. Then, the possibility of excluding these items was individually assessed and, in the end, we opted for non-exclusion, since, according to these authors, this action would not result in a significant increase in composite reliability.

Concerning the determination of the model quality, Cronbach's alpha and the composite reliability (CR) criterion were generated as indicators of internal consistency of the variables. As a criterion, Hair et al., (2011) highlight that the values of these two indicators must be greater than 0.7, with values between 0.6 and 0.7 being acceptable in exploratory research. All results obtained attest to the quality of the model.

Finally, the average variance extracted (AVE) of the factors was used in the analysis of convergent validity. According to Hair, Sarstedt et al. (2014) the AVE values must be greater than 0.5, something achieved in two constructs of the analyzed model (information governance and transaction cost). The fact that the AVE is less than 0.5 in the blockchain construct is linked to the fact that the technology is considered as an information governance mechanism.

When observing that the model reached satisfactory values in the analyzed criteria of reliability and convergent validity, the discriminant validity analysis of the model was performed through a verification of the Fornell-Larcker criterion, as suggested by Hair, Sarstedt et al. (2014). These authors emphasize that the square root of the AVE must be superior to the correlation between the constructs, which was obtained by the model (Appendix D).

Structural model and hypothesis testing

For the evaluation of the structural model, followed by the hypothesis test, a collinearity analysis was initially carried out in order to identify whether there is a high degree of similarity (collinearity) between two constructs. For that, the criterion of the variance inflation factor (VIF) was used, in which, according to Hair, Sarstedt et al. (2014), each tolerance value of the predictor construct (VIF) must be greater than 0.20 and less than 5.00. The results obtained show that all VIF values are adequate (Figure 3 and Appendix D).

After performing the bootstrapping procedure (Appendix D), the main criteria used for the evaluation of the structural model were the R^2 measures (coefficient of determination of dependent factors) and the significance level of the path coefficients (Hair et al., 2011). The R^2 assesses the accuracy of the model's forecast and is a measure of explained variance for each endogenous construct. According to Hair et al. (2011), it is expected that the R^2 levels of the main factors are high, since the PLS-SEM approach aims to predict and explain the variance of the endogenous latent variables. As a parameter, the R^2 values are 0.75, 0.50, or 0.25 for the endogenous latent variables of the structural model as substantial, moderate, or weak, respectively (Hair, Sarstedt et al., 2014).

The R^2 value of the information governance and transaction cost factors is 0.519 and 0.256, respectively. These values are satisfactory and indicate that the predictor variable *blockchain* explains 51.9% of the variance in the dependent variable information governance. In this line, the variable information governance explains 25.6% of the variance in the dependent variable transaction cost (perception). After the analysis of R^2, the level of significance of the path coefficients (hypotheses) was verified, using Student's t-test, which calculates the significance of the model relationships. The analysis of this test is based on the premise that values above 1.96 represent a significance less than 0.05 and, therefore, the hypothesis of the analyzed model is supported, since the null hypothesis of the test was denied (hypothesis of equality) (Hair, Sarstedt et al., 2014). In this sense, it was observed that all values are significant at levels of $p < 0.05$. It is noticed that the model's hypotheses are supported, which allows to identify that the adoption of blockchain technology positively influences information governance (H1), and this one negatively influences transactional costs (H2).

Finally, the size of the f^2 effect was verified to estimate the contribution of an exogenous construct to the R^2 value of an endogenous latent variable and the *blindfolding* procedure to obtain the predictive relevance of the model (Stone-Geisser's Q^2 value for each endogenous construct) (Appendix D). In the analyses performed, it was possible to identify that the estimation of the structural model showed that the model has significant paths. In addition, the values of R^2, f^2, and Q^2 attest to the model's capacity and predictive relevance, being that the hypotheses were supported.

Considerations about the results on Stage 1 — quantitative

The results obtained by the analyses carried out so far confirm the two hypotheses of the model developed. Thus, the research findings, from a quantitative perspective, suggest that the adoption of blockchain technology is positively related to information governance (IG). Furthermore, this positive relationship ends up causing a negative relationship between information governance and perceptions about transactional costs in this context while using blockchain.

During the quantitative analyses, the relationship between the blockchain and information governance constructs became more evident, because the blockchain can be understood as an IG mechanism. Some items that made up the model were eliminated for presenting very low factor loadings when factor analysis was carried out between the blocks. The items excluded from the model were from the following constructs: two from blockchain; four from information governance; and two from transaction cost. The items from blockchain that were excluded were related to the characteristics of distributed power and value as incentive; from information governance, they were related to the characteristics of accountability, accessibility, and compliance;

from transaction cost, they were related to safeguard and default costs. It is noticed that, even with the exclusion of some items, most of the characteristics that generated the various items of the constructs remained.

The results obtained in the quantitative stage show that the H1 and H2 of the study are supported. Thus, the predictor variable blockchain explains 51.9% of the variance in the dependent variable information governance and the variable information governance explains 25.6% of the variance in the dependent variable transaction cost (perception). Therefore, the adoption of blockchain technology can be a mechanism to reduce the transactional costs as it positively impacts information governance.

With regard to blockchain, there was a greater influence of the items related to the categories of: preserved rights, in which there is the question that the use of blockchain would allow the preservation of rights related to the property and use of information, making them clearer, transparent, and applicable; inclusion, which allows a reduction of barriers against the participation of people/organizations in various transactions; and security, related to the characteristic of this technology of having built-in security mechanisms that allow confidentiality, authenticity, and non-repudiation of activities, as well as the identification of incorrect behavior on the network, and the establishment of isolated consequences to the agent who acted recklessly. At the same time, in the information governance construct, there was a greater influence of the items related to the categories of: communication, in which there is the establishment of better communication on practices related to the use of information; sharing, which handles the definition of information exchange policies between the various economic actors in a safe way; and standardization, related to the establishment of standards of information records that promote agility and facilitate information management.

Finally, in the transaction cost construct, there was a greater influence of the items related to the categories of: contract negotiation cost, those costs that occurred during the adjustment period of a contract so that it can be signed; cost linked to credible commitments, which is related to the costs to maintain the guarantees stipulated in a contract, after its signature; and contract drafting cost, costs incurred in writing any contract. This evidence regarding the most influential items in the study is aligned with the unfolding of the confirmation of the relationship between blockchain, information governance, and transaction cost, in which there is a reduction in transaction costs and greater freedom for the firm to choose its production process (internalizing or outsourcing), taking into account that the technological mechanism allows to reduce the impact of behavioral assumptions (bounded rationality and opportunism), decreasing transaction costs. In other words, the impact of behavioral assumptions on economic transactions is lessened by the use of governance mechanisms, and the firm can better decide how to develop its production process. Figure 7 summarizes these results.

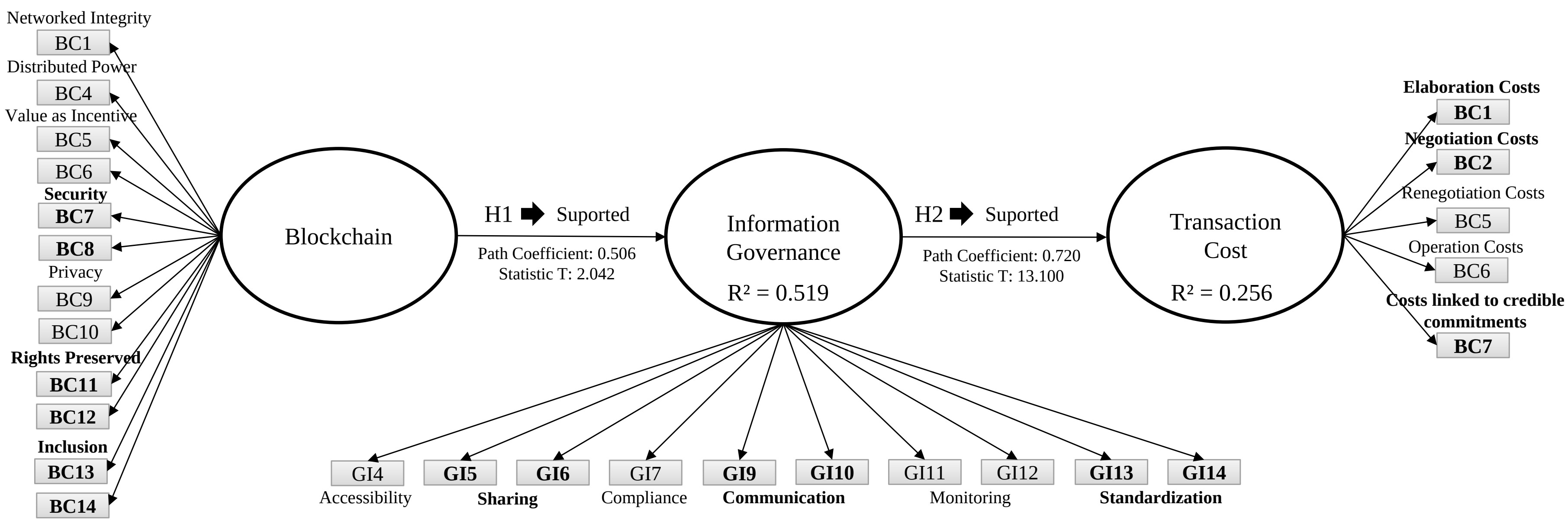

Figure 7. Summary of quantitative results.

In this sense, the results obtained contribute to the transaction cost theory, demonstrating that new technologies (such as blockchain) create new governance mechanisms, which help reduce the relevance of transaction costs for the development of economic activity. Thus, the impact of behavioral assumptions on economic transactions is lessened by the use of governance mechanisms, and the firm can better decide how to develop its production process.

Specifically regarding the blockchain technology, it is highlighted that it, considering its technological characteristics, it enables the development of more distributed transactions. The increasing development of this technology and its adoption means that there is a movement for the decentralization of many activities related to trade. Thus, activities that were previously centered in some organizations due to the confidence factor (i.e., organizations that had the role of providing confidence in organizational exchanges in order to reduce uncertainties and the possibility of some economic agent acting opportunistically) are having their business model modified by a more distributed option, which includes more economic actors in the process.

It should be pointed out that, even if this relationship is put up by the hypotheses of this study that there is a positive impact on information governance and a negative impact on the perception of transaction cost when adopted the blockchain technology, it is necessary to delve deeper into the structure of the blockchain used and its form of use, because this verified relation is related to an adequate use of this technology. In other words, as any technology, its use will have a better cost-benefit when there is a strategic alignment between the business/transaction in which this technology will be used and the adherence of this technology for such use. Therefore, these hypotheses shed light on the fact that there are still many centralized business transactions that generate high transactional costs, which could be reduced by the use of this technology, but the scenario where all enterprise databases are distributed or that all organizations use this technology is not envisioned.

With these supported study hypotheses, one can think of distributed business and governance models, which would connect many more actors and would cause the 'weight' of transactional costs for economic exchanges to be greatly minimized with this technology. Subsequent to the evaluation of the results of structural equation modeling, it is presented below the analyses of the case studies carried out in order to illustrate how the use of blockchain is positively related to information governance and negatively to the transactional costs perceived by economic agents.

Results Stage 2

Case study – Company A

Company A is part of a business group composed of three companies from different segments within the technology area. Located in the southern region of Brazil, it was founded in 2017, and since 2018 it has the participation of a European company as an investor. As a value proposition, it offers its customers (governments and private companies) blockchain technology solutions (more specifically permissioned/private blockchain, i.e., distributed ledger technology – DLT), mainly solutions focused on digital identification and traceability. In addition, in relation to the products offered by this company, the digital identification application stands out, which uses blockchain to record information; it functions as a large portal of services in which various functions can be enabled, such as documents and information about votes, licenses, certificates, and digital signatures. With regard to the current organizational structure, Company A has five people directly involved in the business processes and a representative of the European investor company. Appendix F presents an analysis of the frequency of words of the data analyzed in Company A.

Information governance and blockchain — Company A

It was identified that Company A, through the two main solutions (identity and tracking), ends up generating a positive impact on the items and, consequently, on the information governance (IG) construct of the model. In this section we present the results found that highlight the relationship between the use of blockchain technology and the influence on IG.

Regarding accountability, it was identified that Company A, in the various documents analyzed, always positions itself in order to highlight this characteristic in its solutions based on the immutability characteristic of the blockchain. That is, the company points out that through this technology embedded in its solution, it is possible to identify the person responsible for all actions, map their attitudes, and thus moderate the concerns about fraud. Consequently, the differential of the solution, according to the researched documents, is that all data is kept safe in one place, since fraud-proof technology is used that does not delete any information, hence making all data traceable at any time. Respondent 1's speech points out that

> "one of the advantages that we bring with this solution is the guarantee of non-repudiation precisely because blockchain technology comes in."

It is observed that, as identified in the development of the theoretical model, blockchain assists in the promotion and maintenance of accountability by using a technology in which the saved information is incorruptible and, therefore, accountability is made possible for any action saved in the blockchain (Tsai et al., 2016; Tschorsch & Scheuermann, 2016). In view of this, the use of blockchain extends the accountability capacity, by allowing the identification of a node (person/digital identity) that may have acted in a non-appropriate manner (in the case of Company A's identity solution), or a part of the transactional process that may have a problem (in the case of Company A's tracking solution), since, according to Respondent 2,

> "... you can have very strong control over who did certain action if that person is using a unique identity."

The other analyses on the relationships between the items of the information governance construct and the use of blockchain technology are summarized in the following figure:

IG Item	Summary	*Example of evidence in the interviewees' speech*
Accountability	The possibility of having a strong and effective control over who did a certain action, because a unique identity is being used.	*"one of the advantages we bring with this solution is the guarantee of non-repudiation precisely because the blockchain technology comes in" Interviewee 1 "... you can have a very strong control over who did a certain action if that person is using a unique identity" interviewee 2*
Accessibility	The solutions replace printed documents, centralizing identification data in one place, thus making access to information simpler and more practical.	*"one of the characteristics of Blockchain is that this data is encrypted, only those who have the permission to read will read it, so it is important to note that only the people who should really read that data, who should have access to that information, are the people who will have access to this information" Interviewee 2.*
Sharing	The solutions allow exchanges of information to take place, but always guaranteeing the consent of those who are sharing.	*"before you can do all the services that I brought, you have to validate your identification of your identity, [...] Ok to the extent that I have this validated, I have an identification, a valid identity. From that point on, when I share some information with you, for example, that information is valid and it will only be shared because I am consenting to this. In other words, it is possible to make this exchange of information, but always guaranteeing the consent of those sharing it." Interviewee 1*
Compliance	The use of Blockchain technology in Company A's solutions allows information security policies to be complied with.	*"We are very concerned with bringing security in dealing with personal data, because in fact when we talk about data sharing, which is one of the modules of the solution, the person will be sharing personal data ... so they need to have the assurance that this data will not be leaked or passed on improperly, without her consent." Interviewee 1*
Communication	Company A's solutions allow the information to be traceable and make sure that the posted information has not been altered, facilitating communication.	*"... things much clearer for everyone who participates in that organization" Interviewee 3 "... the idea is to bring security to the transactions you are making. It is a guarantee for the parties, regardless of a formalized contract or not, that what we are saying at that moment is perfected and will be executed later" Interviewee 1*
Monitoring	The possibility to record everything that happened in the process that is being traced and the activities of the holder's digital identity.	*"... it is possible to have greater control over who enters the Club or who is inside, if there is still someone inside and everything ... when it comes to government, for example, we can have much greater access about what the person does in her daily life" Interviewee 2*
Standardization	Standardized bookkeeping among the various Blockchain participants allows fraud prevention and facilitates information auditing.	*"the solution, it is already adhering to the General Law of Data Protection" Interviewee 1*

Figure 8. Case A — Information governance and blockchain relation.

After analyzing the documents and interviews, it was possible to illustrate how the use of blockchain technology in the two main solutions of Company A (digital identification and tracking) positively impact the information governance of users of this solution, corroborating the results identified in the quantitative part of this research. It is identified that the characteristics of blockchain technology, which are the basis of Company A's solutions, allow them to guarantee "... accuracy, integrity, accessibility, and security," which are the information governance objectives (Earley, 2016, p. 17).

In addition, understanding that IG permeates the idea of information protection and, by focusing on information lifecycle management as a whole, aims to provide a better use of information for the generation of value to the organization, it can relate Company A's solutions with the mechanism of generating value for users of these solutions. This value generation is enhanced by the fact that this technology enables more permissive approaches to data use and information sharing, without losing characteristics that ensure the security of this data, which allows the company, according to Tallon et al. (2013), to minimize costs and use of IT solutions not authorized by the organization. The next subsection illustrates the relation between the use of blockchain in Company A's solutions and transactional costs.

Transaction cost and blockchain – Company A

With reference to the perception of Company A regarding the influence of blockchain on transaction costs, it was identified that there is a perception that these costs would be reduced, mainly due to the characteristics of blockchain, which allow the immutability of data and greater information security. Moreover, the process optimization possibilities and the use of blockchain as a trust mechanism would affect transaction costs, reducing them.

Regarding behavioral assumptions (bounded rationality and opportunism), it was found in the analyzed documents and interviews that blockchain affects these two assumptions, reducing their influence on economic transactions. More specifically on bounded rationality, a human condition related to cognitive limits (Simon, 1978) that does not allow all variables to be mapped to the existence of contracts with unlimited complexity (Barney & Hesterly, 2004; Williamson, 1975; 1985), Company A's solutions provide a more reliable way to transact and book more complex contracts. In this sense, Respondent 3 highlighted that, in the solutions offered by Company A, the key point is that

> "... the blockchain gives you more confidence, that what is agreed will not bring you a loss later, be it financially or any other type of dispute."

This security assists, in a more direct way, the reduction of *ex post* transaction costs (default, renegotiation, operation, and those linked to credible commitments).

With regard to opportunism, related to information asymmetry and its use to achieve some advantage (Williamson, 1985), the use of Company A's solutions is highlighted in several documents as a mechanism of transparency and security to impact the decrease in the influence of this variable in transactions, reducing transaction costs. As highlighted by several authors, blockchain helps ensure that transactions are recorded in a secure and immutable manner, restricting some transaction costs (Jeppsson & Olsson, 2017; Nakamoto, 2008; Tsai et al., 2016; Tschorsch & Scheuermann, 2016; Yli-Huumo et al., 2016).

The other analyses on the relationships between transaction cost and the use of blockchain technology are summarized in the following figure:

Impact of adopting companies' solutions on transaction costs	Summary	*Example of evidence in the interviewees' speech*
	Transaction costs would be reduced mainly by the characteristics of the Blockchain that allow data immutability and greater information security.	*"... more security and not only information security, but legal security because [...] there is always the possibility for you to legally plead something [...], it wasn't like that, you have to interpret this contract, but with the bookkeeping from the Blockchain it gets harder" Interviewee 1*
	The possibilities of optimizing processes and using Blockchain as a trust mechanism would affect transaction costs in order to reduce them.	*"You have received a file by email, you can download it on your smartphone and you upload this file into the app, you digitally sign it and share it with someone and it is already signed. So, this whole process you can do on the bus, you don't need to have a computer with you, you don't need to have a good internet connection, you don't need to have another token, card, USB stick, anything ... you can do this much faster." Interviewee 2* *This process (production chain management) has a very high cost for companies [...]. With technology like our solution, you can even automate some parts of the process. Through smarts contracts, you are able to determine pre-conditions and that if these conditions are implemented, they are executed, the contract automatically executes itself. In other words, [...] you can have it automated and you can, in a faster way and in real time, understand where there may be a hole or a fault and make this correction immediately. [...] As you have everything registered on Blockchain, you can do all this tracking on everything and look for where the problem occurred and be able to make adjustments. Interviewee 1*
	Decreased influence of behavioral assumptions (Limited Rationality and Opportunism in economic transactions).	*"the Blockchain gives you more confidence, that what is agreed there will not bring you a loss later, both financially, or any other type of dispute". Interviewee 3*

Figure 9. Case A — Transaction cost and blockchain relation.

In this way, the use of blockchain can reduce, as already mentioned, the influence of behavioral assumptions (bounded rationality and opportunism) in transactions, hence decreasing transaction costs that mainly impact operations involving a specific asset, whether in an environment of uncertainty or the ones that are rarely made (critical dimensions to transcribe a transaction, according to Williamson [1981]). This possibility reduces transactional dependency, mentioned by Faria, Arruda, Di Serio, & Pereira (2014), among companies in a transaction that has a higher degree of asset specificity, in addition to contributing to what is already being observed in the literature: the use of blockchain for cases of specific assets that need further tracking and recording their specificities during the process, which generates greater confidence in carrying out transactions with this type of asset between economic actors (Lucena et al., 2018).

It is worth mentioning that, in these cases, the use of blockchain is normally complemented with other technologies, such as internet of things (IoT) devices that allow the automation of processes and bring greater strictness to the collection of data that will be saved in the blockchain. That is because, according to Respondent 1,

> "... blockchain alone won't give you everything. But if you make a set of technologies and this being registered in the blockchain, the consumers, for example, will have the guarantee that what they are consuming or using has actually gone through the quality process that the company says it uses. So it's good for a company that adds value to its product, right, and it's good for the consumers because they will know what they are consuming, if that is really within their expectations."

In view of the analyzed data from Company A, it was possible to illustrate how the use of blockchain technology in its two main solutions (digital identification and tracking) negatively impact the transaction cost, corroborating the results identified in the quantitative part of this research. It was observed, based on the solutions of Company A, that the blockchain technology can be seen as a trust mechanism that facilitates economic exchanges outside organizational limits, while minimizing the effects of behavioral assumptions (bounded rationality and opportunism) on economic exchanges. It is reinforced, with the case of Company A, that there is no identification and perception that the solutions of this company could cause the absence of the transaction cost, as highlighted by Tapscott and Tapscott (2017), but there is the perception of a decrease in the transaction cost. Thus, the case illustrates that the use of blockchain, in specific contexts, can be a mechanism to minimize these costs and presents itself as an efficient model for structuring and protecting data.

Case study – Company B

Company B was created in 2015 in the southeast region of Brazil, with the aim of changing the way people deal with issues related to the authenticity of people, contracts, documents, and digital files through the use of blockchain technology. In addition to Brazil, this company is registered in Estonia (Europe), in order to facilitate the use of the solution by members of the European Union.

All services offered by Company B are accessed via a fully automated and secure online platform. This company is connected to four major blockchain: bitcoin, ethereum classic, ethereum, and decred. Regarding the services provided by Company B, there are the following possibilities:

collection of public evidence on online content, certifying it on blockchain; certification and verification of the authenticity of documents and digital files, including contracts; and digital identity, which allows the signature of digital files with proof of authorship, in addition to enabling authentication on websites and platforms. Finally, in relation to the current organizational structure, Company B has two founding partners, four investors/directors, and eight employees.

Appendix F presents an analysis of the frequency of words of the data analyzed in Company B.

Information governance and blockchain – Company B

From the data analysis performed, it was identified that Company B positively impacts information governance through its solutions related to document signature/certification and blockchain identity. Thus, subsequently, the results found that highlight this relationship between the use of blockchain technology and the influence on IG are exposed.

Regarding the item related to the capacity for accountability, it was identified that Company B, based on its solutions, authorizes the registration of several documents on the blockchain, attesting the veracity of that information and thus allowing accountability. According to the analyzed documents, Company B comes out with the ambition to facilitate the preservation of intellectual property, considering that, for example, musicians had great difficulty in registering the authenticity of their works, as the process was slow and laborious. Something to stand out in this regard is that according to Brazilian Copyright Law 9,610/98 it is defined that the right 'is born' with the work and, therefore, there is no obligation to formally register a work. However, Respondent 4 emphasized that

> "... in the event of a dispute, any dispute whether you did it first or not, you need to prove antecedents. And that's when blockchain, by giving you a timestamp that proves the existence, authenticity of that document and the date that that document existed, allows you to have a proof, a very strong evidence of precedence of the authorial content."

In other words, in this case, you are able to identify the true author of the work and hold the individual who is not the author of the work responsible.

Another example related to Company B's solutions that positively influence accountability is the digital signature and the blockchain identity. In this context, it was observed, in the various documents of the company, the emphasis for the fact that the electronic signature without the identity validation of the person who is signing is considered something fragile, as it can be highly corruptible. Also according to the documents analyzed – with the exception of digital certificates in which ICP-BR licenses some companies to operationalize their sale –, there is a kind of public faith since the identity of this individual who is signing has already been validated by an agent licensed by the government. The rest of the electronic signatures are highlighted as fragile whereas normally you just click on a link and it is signed. In this sense, Respondent 4 shows that this fragility in signatures would make accountability more difficult, since

> "... if the person wants to forward this email with the link or leaves the computer logged on, someone else can click on it and then the person might say 'oops, I didn't sign it,' and then to prove that it was the person who signed it becomes very difficult, because you don't have enough elements to prove the identity of whoever signed it, right, since you sign it by clicking on a link."

Motivated by this problem, Company B designs a protocol for the validation of identity through digital means that would make it possible to expand accountability in this context. With the protocol design ready, an entity approached Company B to try to use that protocol to sign a bill; a project was then developed with this entity that ended up winning Google.org's Impact Challenge. The developed project is on the market and two laws were created and approved in Brazil based on petitions that started with the developed solution. This was only possible because, according to Respondent 4, the solution

> "uses the entire blockchain identity, signature, and registration layer created by us, Company B."

Historically, Company B started with the authenticity of documents and then added the signature to its portfolio and, because of that, it was necessary to develop a more robust structure. For Respondent 4, Company B ended up

> "... setting up an end-to-end platform for digital governance that manages to improve the governance process, because starting from identity, and from the moment you validate the person's identity and issue the digital identity, you can do authentication, signature, authorization, and document authentication. So it is practically an end-to-end e-vote digital governance platform" (Respondent 4).

It is important to note that Company B's proof of authenticity record was used and accepted by Brazilian courts. According to the documents analyzed, the case discusses the exclusion of posts that are allegedly offensive to a politician on social networks. The author of the case registered the online content in the blockchain as a way of proving their existence, which was acknowledged by the case reporter who denied the request for advance protection while the author, when registering the content from Company B's platform, provided the preservation of all the content via blockchain, being able to prove the veracity and existence of the contents. Therefore, the use of this tool facilitates the accountability process by allowing the registration of information without, however, changing or copying it, and in addition, it makes blockchain a great ally in the conduct of processes in the legal sector. By using blockchain technology for this purpose, it is ensured that the information saved is incorruptible and it becomes possible to take responsibility for any action saved in the blockchain (Tsai et al., 2016; Tschorsch & Scheuermann, 2016).

The other analyses on the relationships between the items of the information governance construct and the use of blockchain technology are summarized in the following figure:

<table>
<tr><th>IG Item</th><th>Summary</th><th>Example of evidence in the interviewees' speech</th></tr>
<tr><td>Accountability</td><td>The possibility to register several documents on the Blockchain in order to attest to the veracity of that information and thus allow for accountability.</td><td>“in case of dispute, any dispute whether you did it first or not, you need to prove it in advance. And that is where Blockchain giving you a timestamp that proves the existence, authenticity of that document and the date which that document existed, allows you to have a proof, a very strong evidence of precedence of the authorial content”. Interviewee 4</td></tr>
<tr><td>Accessibility</td><td>The value proposition of Company B is aimed at guaranteeing authenticity and not necessarily the accessibility of the information itself.</td><td rowspan="2">the company's focus “has always been to guarantee the authenticity of everything without having any documents, thus maintaining confidentiality and privacy in relation to the documents of the users of our platform”.
Interviewee 4</td></tr>
<tr><td>Sharing</td><td>The Company B platform does not share information, documents, but documents authentication or digital identity. In this sense, the services of Company B influence in order to improve the quality of the information shared.</td></tr>
<tr><td>Compliance</td><td>The decentralized identity solution allows companies to securely store user data and follow the necessary GDPR rules and regulations. This solution makes it easier for companies to comply with data regulations such as LGPD.</td><td rowspan="2">Focus on transparency. It seeks to demystify that “... false idea that security occurs when you hide information. Because security occurs when you have transparency in the processes without exposing the confidential content, but that everything can be verified, audited and tracked. If all of this, if the process tracking is clear, you decrease the incidence of fraud, the risk of fraud.”.
Interviewee 4</td></tr>
<tr><td>Communication</td><td>Company B positively impacts the communication item, but not directly, by being a message or communication portal, but by increasing information security in relation to its veracity and allowing transparency in informational exchanges with the Blockchain identity.</td></tr>
<tr><td>Monitoring</td><td>Company B solutions allow greater control and monitoring over the use of information, in addition to guaranteeing legal proof so that the individual who acts opportunistically in a transaction can be held responsible.</td><td rowspan="2">“users know what data is being collected by a company, and the company that collects the data has proof that it has collected that data with the consent of the information owner”.
Interviewee 4</td></tr>
<tr><td>Standardization</td><td>It allows users of these solutions to use them as a way of adapting, for example, with the general law of data protection.</td></tr>
</table>

Figure 10. Case B — Information governance and blockchain relation.

By analyzing the documents and interviews, it was possible to illustrate how the use of blockchain technology in the solutions of Company B positively impacts the information governance of the users of this solution, corroborating the results identified in the quantitative part of this research. The presented results reinforce the fact that the characteristics of the blockchain technology enable the guarantee of the objectives of information governance, that is, they guarantee "... accuracy, integrity, accessibility, and security," which are the objectives of information governance (Earley, 2016, p. 17).

Still, with the presented analyses, the issue that information governance is beyond data protection is reinforced, making reference, therefore, to the entire information lifecycle management, enabling a greater generation of value for the company. In this sense, all of Company B's solutions contribute to the generation of transparency and security in transactions.

Transaction cost and blockchain – Company B

In relation to the perception of Company B regarding the influence of blockchain on transactional costs, it was identified that there is a perception that these costs would be reduced mainly by the characteristics of blockchain, which allow greater information security to end up modifying various processes, making them less bureaucratic, simpler, and agile. Therefore, it is visualized on this technology a potential for process optimization and reduction of transactional costs in situations that require a reliability mechanism. This section presents how Company B realizes that its solutions affect transaction costs.

When analyzing the data on Company B's services, it was noticed that, in relation to the behavioral assumptions of the transaction cost theory (bounded rationality and opportunism), the use of blockchain technology, as the basis for the value generation of Company B, causes the reduction of the influence of these assumptions on economic transactions. Bounded rationality, a human condition related to cognitive limits (Simon, 1978), which does not allow all variables to be mapped to the existence of contracts with unlimited complexity (Barney & Hesterly, 2004; Williamson, 1975; 1985), is also related to uncertainty.

In this sense, many times, in economic exchanges, several types of mechanisms are adhered, which enable to slightly reduce this uncertainty. However, these mechanisms sometimes stiffen the possibilities of choice and increase costs. As a result, Company B's solutions allow reducing informational uncertainty, attesting to the veracity of documents and identity, then becoming mechanisms that help the establishment of a more reliable way of trading and bookkeeping contracts that are more complex. According to the documents analyzed from the blockchain identity solution, digital identification is made possible, reducing the need for passwords or filling out forms. In 2018, Company B certified more than 100,000 records, reducing more than one million hours, which were spent on bureaucratic procedures. This is because this security (decreased uncertainty), brought by the solutions of Company B, helps in reducing *ex post* costs (default, renegotiation, operation, and those linked to credible commitments).

With regard to opportunism, related to the asymmetry of information and its use to achieve some advantage (Williamson, 1985), the use of Company B's solutions is highlighted in several documents as a mechanism of transparency, trust, and security to impact on the decrease in the influence of this variable on transactions, reducing the transactional costs. The characteristics of the blockchain technology are those that allow, for example, the accountability of an economic agent acting in bad faith and the reduction of some transactional costs (Jeppsson & Olsson, 2017; Nakamoto, 2008; Tsai et al., 2016; Tschorsch & Scheuermann, 2016; Yli-Huumo et al., 2016).

As an example about this issue of opportunism, the application of Company B's solutions as a mechanism of legal certainty for companies is explored. Noteworthy is the example of the online petition signing platform, where its great differential is the use of Company B's technology that makes use of the blockchain. This is because on this platform there is verification of the identity of the user, ensuring legal validity of the collected signatures. Thus, even with a process all digitized, the authorities have confidence that in that petition there are no ghost citizens, or that the same citizen is not there twice, for example. All this facilitates the processes and generates more security about the information contained in the petitions. That is, there is time savings, promotion of citizenship, promotion of trust, and reduction of the transactional costs in this type of application.

The other analyses on the relationships between transaction cost and the use of blockchain technology are summarized in the following figure:

Impact of adopting companies' solutions on transaction costs	Summary	*Example of evidence in the interviewees' speech*
	Transaction costs would be reduced mainly by the characteristics of the Blockchain that allow greater information security and end up modifying several processes making them less bureaucratic and, thus, simpler and more agile.	*"[...] what you do in Blockchain, in fact, is.... let's talk about 'notarization' of the process, so when they send you a document, I ask ahh ... is this version ok or not, if you return a no, I will have a record registered in Blockchain in a media where no one will be able to change what you said that it was not good, then I make the changes you requested and send it again. The moment you give the OK, this recorded history in Blockchain is proving that you said on such date and such time that it is in accordance with document X and that it is sufficient, this is registered in Blockchain, which is a public media, other processes that will start after your OK, they can start working automatically, they can start running, they don't need anyone to go there and press a button, because the media where your OK is registered is public, so if you have any other process looking and waiting for your OK, from the moment you gave your OK, the other process starts and other processes start after those, keeping this audit trail all recorded where you will mitigate more costs ." Interviewee 4.*
	Potential to optimize processes and reduce transaction costs in situations that require a trust mechanism.	
	The use of Blockchain, in specific contexts, can be a mechanism for minimizing transactional costs and presents itself as an efficient model for structuring data for the expansion of trust and legal protection.	*This is all because with the use of Blockchain technology we have the guarantee of "non-repudiation, because you can even say that you did not do something, but you left so many digital tracks on a media that cannot be changed. [...] you created evidence that you were actually negotiating, agreed / concurred with that content and that the other process started only after your agreement. If there were not all this tracking of the process, you could go to court and say 'I didn't do it', 'the next process started before I agreed,' and then the costs that would be incurred in resolving this dispute would be much higher. So, one thing you have to consider is that, with the use of our solutions, you prevent other bigger problems and more costs from happening." Interviewee 4. "the cost of registering in Blockchain is marginal to the whole process. So, the costs are very low, the values are not representative when you put this cost in the final value of the trade itself and they also represent nothing when you look at the whole and the potential problems that this blockchain record mitigated in the future". Interviewee 4.*

Figure 11. Case B — Transaction cost and blockchain relation.

In this way, the use of blockchain technology has an impact that reduces the influence of behavioral assumptions (bounded rationality and opportunism) on transactions. This ultimately reduces the transactional costs of transactions involving specific assets, that are in an environment of uncertainty, or that are rarely made (critical dimensions to transcribe a transaction, according to Williamson [1981]), since it is in this type of transaction that there is the greatest influence of the transactional costs. All the examples described on the use of Company B's solutions highlight the issue of simplification of processes and increased trust, which restrict transactional dependence, mentioned by Faria et al. (2014), among the companies where a transaction would have a higher degree of asset specificity.

In view of the analyzed data from Company B, it was possible to illustrate how the use of blockchain technology in its solutions negatively impacts transaction cost, corroborating the results identified in the quantitative part of this research. It was verified, using these solutions, that, as identified in Company A, blockchain technology can be seen as a reliable mechanism that facilitates economic exchanges outside organizational limits, while minimizing the effects of behavioral assumptions (bounded rationality and opportunism) on economic exchanges. Thus, the case illustrates that the use of blockchain, in specific contexts, can be a mechanism to minimize the transactional costs and presents itself as an efficient model of data structuring for the expansion of trust and legal protection. Finally, it is noteworthy that at no time was it identified in the analyzed data that this technology would have the potential to extinguish these costs, as mentioned by Tapscott and Tapscott (2017).

Considerations on Cases A and B

In the two analyzed cases, evidence was identified that made it possible to illustrate the results obtained in the quantitative phase of the study, that blockchain technology enables a positive influence on information governance and, due to this influence, there is a reduction in transaction costs. Something interesting to note is that in these two studied cases there is the use of blockchain for the purpose of digital signature and identity. However, even offering similar services, the blockchain infrastructure chosen to offer the solutions is different in these two companies.

Company A chooses to offer a private or permissioned blockchain structuring (distributed ledger technology — DLT) to its customers, working with what they call an 'in-house' license, in which the entire infrastructure is installed on the client, as highlighted by Respondent 1:

> "Today the entire infrastructure is on the client. Today we work with permissioned blockchain right, not with public blockchain. So, the control of the blockchain is the customer's. We keep the characteristics, which sometimes receive criticisms like 'oh, but your blockchain is permissioned and you don't guarantee the decentralization issue, you do not guarantee the distribution and everything...' No, in fact there may be a permissioned blockchain where you distribute the nodes among partners, in a partner network, right? And you have the guarantee of immutability, of transparency, right? And also the security that the information is registered, validated and wasn't altered at all."

Company B uses large networks of blockchain (bitcoin, ethereum classic, ethereum, and decred) to operationalize all its solutions and does not require its customers to have a specific infrastructure installed in their companies. To use Company B's services, simply access the website or the application. The option to develop the solutions through the blockchain public networks is fully aligned with the factor that in this type of blockchain there is a large distribution and breaking the consensus is something much more difficult due to the issue of distribution. Respondent 4 pointed out that Company B's solutions follow the

> "… premise that you never put sensitive data on blockchain, public or private. We start from a premise that you never put sensitive data on blockchain, public or private, because from the moment you … record information, even if encrypted on the ledger where there is alteration or deletion, removal of information is very difficult because it requires consensus, you may have a problem that if these keys are leaked only once, this data may be recovered forever, because it cannot be deleted."

Therefore, it was verified with these two cases that it is not the fact of being private or public that defines the blockchain's potential to contribute to information governance and decrease of the transactional costs, since evidence was found in the two analyzed cases that illustrated the existence of this influence, identified initially in the literature and in the quantitative phase of this research. However, the use of DLT (private blockchain) requires the existence of a more complex technology deployment process and that it must be transparent so that the properties of blockchain technology are not lost. Another relevant point to be highlighted is the fact that it is necessary to analyze at what point during the transactional processes the adoption of this technology is relevant, since blockchain is, as highlighted by Respondent 4,

> "… the most expensive and slowest database that exists, considering the characteristic of distribution and decentralization. So, you have to put it on a scale: if you want performance, you will not have distribution and decentralization, if you want distribution and decentralization, performance will go down."

Thus, it was noted, on both analyzed cases, the perception that the market bigger understanding about what really is the technology and for what uses it makes more sense is necessary for a greater adoption of such technology, highlighting the importance of adopting the technology with strategic focus. It was also found that there is no problem with processes that do not adopt it, as not all organizational information needs and should be on a blockchain.

Case study — Company C

Company C was founded in 2016 in England, with the objective of being a decentralized social impact network built on blockchain ethereum. In this way, Company C's value proposition is to help social organizations (charities, NGOs, social enterprises) execute projects transparently, using smart contract-based incentives to ensure their impact is independently verified and accessible to all.

Regarding the potential impacts of Company C's services, it is highlighted that, as described in the company's white paper, the use of the platform makes it easier for funders (philanthropic organizations, impact investors, small donors) to identify and scale social projects that are proven to work, reducing due diligence, reporting, and other transaction costs. Finally, in relation to the current organizational structure, Company C has two founding partners and six employees.

Appendix F presents an analysis of the frequency of words of the data analyzed in Company C.

Information governance and blockchain – Company C

In view of the data analysis carried out, it was identified that Company C positively impacts information governance through its social financing and impact management platform. This section exposes the results found that highlight this relationship between the use of blockchain technology and the influence on IG.

In relation to accountability, it was noticed that the Company C's solution, according to the documents analyzed, allows the registration of all stages of the social project to release resources only when the objectives of these projects are being met. Accountability is also related to two other capabilities: the ability to know what an actor is doing and the ability to make that actor do something else (Hale, 2008; Faria, 2013; Schedler, 1999). In this sense, the registration of the project on the Company C platform with the description of the objectives, goals, and measurement methods helps the investor have the ability to know what is being done in the project that an investment was made, at the same time as the release of funds condition by objective accomplished ends up executing the ability to make the actor do something else (the project), in case they are not executing it as agreed. This process was highlighted by Respondent 5 in Figure 12.

It should be noted that there are consequences to be applied to the organization that misses a report submission deadline. In the analyzed documents, the highlight was that there is not only the loss of payment for the reports, but also the blocking of all future payments (such as the goal achievement results validated in the future), until the report is sent. In other words, there is a control and accountability mechanism for the institutions that do not send their reports by releasing money or not. The other analyses on the relationships between the items of the information governance construct and the use of blockchain technology are summarized in the following figure:

GI Item	Summary	*Example of evidence in the interviewees' speech*
Accountability	The registration of the project on the platform of Company C with the description of the objectives, goals and forms of measurement helps the investor to have the ability to know what is being done in the project that an investment was made, at the same time as the release condition of funds by objective accomplished ends up executing the ability to make the actor do something else (the project), if he/she is not executing it as agreed.	*"[...] Blockchain records everything, records how much money you have, what chunk of the money was designated to each goal and you have everything transparent [...]." Interviewee 5*
Accessibility	The company seeks to give accessibility to its target audience (projects, investors, social institutions) from an easy-to-use platform, in which users do not need to understand Blockchain, to know how to program.	*"who doesn't know anything about Blockchain, go ahead, it's a normal website that you access with your credit card and you can check it in a more accessible way, that objective used 2 pounds of your money and there are still 8 to be used and you will receiving these updates". Interviewee 5*
Sharing	The contribution reward mechanism aims to be an incentive to share information between the actors involved in the projects.	*"rewards users for adding value to the impact data provided by the various projects on the network, effectively encouraging the creation of a huge searchable database of information on any impact area". Interviewee 5*
Compliance	In addition to auditing about whether or not the project objectives are being met to release more resources, Company C is developing an application to create standardized contracts of impact investment.	*"We are very concerned about bringing this security in dealing with personal data, because in fact when they will be leaked or passed on improperly, without her consent. Interviewee 1*
Communication	Company C's platform is designed to improve the exchange of information between investors and social projects.	*"you can choose the terms, the investment clauses, place and reward the people who wrote the clause and make it all, create, like, a computer program, you cannot deviate from what is written there.". Interviewee 5*
Monitoring	Essential feature for the functioning of Company C applications, as monitoring mechanisms are needed to verify that the projects are meeting their goals and releasing information about the social impact they are causing so that more money can be allocated to the project.	*"the money remains still in a 'savings account' and only when the result that the NGO proposed is reached, it presents a proof and the validator checks the proof, then he/she gives a 'tick'" Interviewee 5*
Standardization	Company C's solutions are focused on making impact information more transparent and for that, they seek, through reward, to create a standard on what information is relevant for measuring social impact.	*The possibility of creating standard contracts for impact investments ends up, according to Interviewee 5, for generating "more transparency about how they work" Interviewee 5*

Figure 12. Case C — Information governance and blockchain relation.

Thus, by analyzing all documents and interviews, it was possible to illustrate how the use of blockchain technology in Company C's solutions positively impacts the information governance of all stakeholders who use the company's platform, corroborating the results identified in the quantitative part of this thesis. The results presented highlight that the characteristics of this technology allow the guarantee of the objectives of information governance, that is, they generate "accuracy, integrity, accessibility, and security" (Earley, 2016, p. 17) even if in different applications and business objectives. Finally, it should be noted that the presented analyses reinforce that information governance is much more than data protection, it can be a source of value generation for organizations through the management of the entire information lifecycle, as in the case of Company C.

Transaction cost and blockchain – Company C

With regard to Company C's perception concerning the influence of blockchain on transactional cost, it was identified that there is a perception in which these costs would be reduced, mainly due to their characteristics, allowing for greater information security and transparency. In this sense, Company C's solution would provide a favorable environment to increase funding for social impact projects, which was already highlighted by the company's founding partners in white paper as something essential for this market, given that investment in social projects is stagnant and one of the reasons is the uncertainty about the execution of the projects or their results/impact. Thus, this section presents how Company C perceives that its solutions affect transaction costs.

When analyzing the data on Company C's solution, it was noticed that, in relation to the behavioral assumptions of the theory of transaction costs (bounded rationality and opportunism), the use of blockchain technology, as a basis for the generation of value of this company, causes the influence of these assumptions to decrease in economic transactions. The entire value proposition of Company C has the objective of reducing investors' uncertainty regarding the real application of their resources and more than that, verifying the true social impact that the resources invested in a social project have generated. This impact reduces investor's limited rationality and, as outlined in their white paper, "makes it much easier for funders (philanthropic organizations, impact investors, small donors) to identify and scale resources for social projects that have proven to work, reducing due diligence, reporting and other transaction costs." In other words, as mentioned in the company's guide document, all the security brought by Company C's solutions to the environment of donations and social impact investments help reduce transaction costs.

In relation to opportunism, related to information asymmetry and its use to achieve some advantage (Williamson, 1985), the use of Company C's solutions is a mechanism of transparency and confidence generation between donor/investor and social project that impacts on decreasing the influence of this variable on transactions, hence reducing transaction costs. Another issue is to monitor whether the project is meeting the goals for the release of resources or not, which means that there is no risk of misuse of resources, thus reducing some transaction costs (Jeppsson & Olsson, 2017; Nakamoto, 2008; Tsai et al., 2016; Tschorsch & Scheuermann, 2016; Yli-Huumo et al., 2016).

In this way, as highlighted by Respondent 5,

> "... using this solution, donors, investors, the foundations that donate to your project, will have much more access to what happens, so their confidence will increase, so they will donate more, because they believe more in you."

Therefore, with the use of the solution, there will be more transparency, trust, and incentives so that none of the stakeholders act in an opportunistic manner, mitigating transaction costs, which arise from insecurity and the need to create governance mechanisms, allowing the company to be able to carry out a transaction without any kind of problem. In this sense, the company's founders point out in the white paper that "transaction costs are a major barrier to the growth of the social sector mainly due to the administrative burden of impact management" and that the use of blockchain technology on Company C's platform would help ease the burden of these costs in the sector.

The other analyses on the relationships between transaction cost and the use of blockchain technology are summarized in the following figure:

	Summary	*Evidence example*
Impact of adopting companies' solutions on transaction costs	Transaction costs would be reduced mainly by the characteristics of Blockchain that allow for greater information security and transparency.	*It makes it much easier for funders (philanthropic organizations, impact investors, small donors) to identify and scale resources for social projects that are proven to work, reducing due diligence, reporting and other transaction costs"* *White paper*
	The solutions of Company C allow to diminish the uncertainty of the investors as to the real application of its resources and more than that, to verify the real social impact that the invested resources in a social project generated.	*"using this solution, donors, investors, foundations that donate to your project, will have much more access to what happens, so their confidence will increase, so they will donate more, because they believe more in you".* *Interviewee 5*
	The security brought by Company C's solutions to the environment of donations and social investments of impact help to reduce transaction costs.	*"transaction costs are a major barrier to the growth of the social sector mainly due to the administrative charges from the impact management"* *White paper*

Figure 13. Case C – Transaction cost and blockchain relation.

In the analysis carried out, it was noticed that Company C's solutions enable the simplification of the processes and the increase of confidence so that there is a growth of investment in social impact projects. Likewise, mechanisms that allow the effective reduction of transaction costs were also noticed. Therefore, in view of the analyzed data, it was possible to illustrate how the use of blockchain technology in this company's solutions negatively impacts transaction cost, corroborating the results identified in the quantitative part of this research.

It was observed that, as identified in Companies A and B, blockchain technology can be seen as a trust mechanism that facilitates the occurrence of transactions between economic agents by minimizing the effects of behavioral assumptions (bounded rationality and opportunism), developing a more transparent and reliable environment. The case, as the others analyzed, contributed to illustrate that the use of this technology is a mechanism for minimizing transaction costs, since it is an efficient model for structuring data to increase confidence. Hence, the study brings evidences that magnify and deepen the results of Hooper and Holtbrügge (2020) study about this thematic.

DISCUSSION AND FINAL CONSIDERATIONS

This article achieved its objective by analyzing the effects of the adoption of blockchain on information governance and transaction cost. The results obtained in Stage 1 of the study support the proposed hypotheses and demonstrate that the adoption of blockchain technology is positively related to information governance (IG) and the results of Step 2 illustrate the relationships of the validated model. Furthermore, this positive relationship ends up causing a negative relationship between information governance and perceptions about the transactional costs in this context while using blockchain. Thus, the predictor variable blockchain explains 51.9% of the variance in the dependent variable information governance and the variable information governance explains 25.6% of the variance in the dependent variable transaction cost (perception). Therefore, the adoption of blockchain technology can be a mechanism to reduce the transactional costs as it positively impacts information governance.

In this sense, the results obtained contribute to the transaction cost theory, demonstrating that new technologies (such as blockchain) create new mechanisms and governance structures, which help reduce the relevance of the transaction costs for the development of economic activity. In addition, the research contributes to a greater understanding related to the application of the blockchain, promoting, as well, the opening/expansion of the debate about costs and benefits of this technology (Risius & Spohrer, 2017), highlighting its influence to minimize costs in economic transactions, from its unique characteristics of data structuring and operationalization. These discussions provide relevant insights regarding the use of blockchain and the impacts on contemporary business processes and models (Avital et al., 2016; Beck et al., 2016; Lindman et al., 2017), as well as on elements that impact transaction costs and that might be considered in the definition of more effective governance structures. Ultimately, it is emphasized, as a theoretical contribution, the validation of the presented model. Despite efforts in the field, there were no studies that linked blockchain technology and TCT, based on information governance.

Furthermore, the results obtained allowed the expansion of the perspective of van Pelt, Jansen, Baars and Sietse Overbeek (2020) on blockchain governance by envisioning this technology as an information governance mechanism for organizations, exploring beyond internal governance of technology and its way of structuring. Thus, it is noteworthy the conjunct relevance of the study of these two views about governance for greater benefits of the adoption of this technology. In addition, the study brought evidence on the relationship between blockchain and transactional costs in order to highlight that they can be reduced, regardless of the type of blockchain (public/private), expanding and deepening the results brought in the study by Hooper and Holtbrügge (2020) on this theme.

Turning to the blockchain technology and its characteristics (such as the possibility of developing more distributed transactions), it is clear that the growing development of this technology and its adoption cause a movement toward the decentralization of many trade related activities. This is because the activities that were previously centralized in some organizations due to the confidence factor (i.e., organizations that had the role of providing confidence in organizational exchanges in order to reduce uncertainties and the possibility for some economic agent to act opportunistically) are having its business model modified by a more distributed option, which includes more economic actors in the process. Wherefore, the relevance of this technology is highlighted due to its unique structure that makes it possible to change the transactional structures that allow the establishment of different business models. In this sense, the possibility of disintermediation of transactions, guaranteeing security and greater access to transactional agents, is what makes looking at this technology necessary, since it affects the relationship of economic agents and transactions, reducing the relevance of some variables for the decision-making and expanding security for the different transactional agents.

Even if the relation provided by the hypotheses of this study is posed that there is a positive impact on information governance and a negative impact on the perception of transaction cost when adopting the blockchain technology, it is necessary to go deeper into the structure of blockchain used and its form of use, as, like any technology, it will have a better cost-benefit ratio for certain applications, as identified in the different uses of the analyzed cases. Therefore, these hypotheses shed light on the fact that there are still many centralized business transactions that generate high transactional costs, which could be reduced by the use of this technology, but the scenario where all enterprise databases are distributed or that all organizations use this technology is not envisioned.

As a result of the hypotheses supported in this study, it is possible to glimpse the existence (or possibilities of operationalization) of distributed business and governance models, which would connect many more actors from this specific technology and would cause the 'weight' of transactional costs for economic exchanges to be greatly minimized. That said, it is suggested that future studies should be carried out that focus on detecting which new types of business governance structures would arise from the use of blockchain. Still, future studies can identify which types of operations are most benefited with the use of blockchain in the perspective of improving information governance and which characteristics of this technology have the greatest impact in different areas of information governance, in different application contexts.

In addition, it was identified that the appearance of new technologies and the current digitally focused context increase the relevance of the theme related to information governance, being increasingly emerging the necessity of researches that study new ways of improving and practicing information governance and its impacts on the organization. These studies need to be linked to analysis in relation to the transactional costs, as these being reduced, there will be a greater impact on the existing forms of relationship and economic exchanges, allowing for a disruption in what we know about economic transactions. The disintermediation provided by blockchain is one of the changes that is generating new business models and transaction forms.

Finally, we point out that the limitation of the study's perceptions is linked to internal agents of organizations that provide technological solutions from the use of blockchain. We opted for this strategy due to the maturity of these agents and technical knowledge about the technology and its application, as well as the fact that the customers of these companies that use blockchain technology from an interface know the benefits, but do not necessarily know how these benefits are generated/achieved. Therefore, as there is greater adoption and dissemination of this technology, it is suggested to apply the study collecting the perspective of customers using technologies that use blockchain.

NOTE

[1] Crunchbase is an international repository created to have the main registry of the most innovative companies in the world. It has commercial information on more than 100,000 global companies (not just startups). Source: https://about.crunchbase.com/about-us

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1st author: conceptualization (equal), data curation (equal), formal analysis (equal), funding acquisition (equal), investigation (equal), methodology (equal), project administration (equal), resources (equal), software (equal), supervision (equal), validation (equal), visualization (equal), writing-original draft (lead), writing-review & editing (lead).

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APPENDIX A

SURVEY

PART 1 – IDENTIFICATION

Company:
Company field of action:
Company size:
Company founded date:

Age:
School/Academic formation:
Job title:
Sector where you work:
How long has been working for the company:
How long has been in this field of knowledge:
How long has been working with projects that evolve blockchain:

What are your perceptions about your knowledge level of what is the blockchain technology? – Likert of seven points

PART 2 – BLOCKCHAIN – Likert of seven points [Initial categories from Tapscott and Tapscott (2017)]

In relation to the adoption of blockchain technologies in organizations, check the level of your agreement related to the sentences below:

BC1 (NI) the record of all stages of the transactional process can be made directly and safely

BC2 (NI) blockchain's technological structure (decision-making, incentive, and operations) makes acting in a corrupt way impossible or costing much more time, money, energy, and reputation

BC3 (DP) the data distribution is done safely and it is possible to eliminate some intermediaries

BC4 (DP) data distribution allows the development of new transactional models

BC5 (VI) the adoption of this technology allows the alignment of the incentives from all interested parties to don't act opportunistically

BC6 (VI) the finance incentives stipulated in the adoption of this technology are adequate to cooperate effectively, avoiding participants' misbehavior

BC7 (SE) security measures are embedded in blockchain's network, providing not only confidentiality but also authenticity and no repudiation of all activities

BC8 (SE) from this technology one can identify wrong behaviors, holding the person who behaved recklessly responsible and in isolation

BC9 (PR) the adoption enables greater opportunity for control over data

BC10 (PR) the right to decide what, when, how, and how much of your identities to share with anyone else is extended

BC11 (RP) property rights are transparent and applicable

BC12 (RP) the adoption of this technology allows the preservation of rights related to the use of information more efficiently

BC13 (IC) reduction of barriers to participation of people/organization in the various transactions

BC14 (IC) allows transactions with new economic actors that weren't possible previously

NI (Networked Integrity); DP (Distributed Power); VI (Value as Incentive); SE (Security); PR (Privacy); RP (Rights Preserved); IC (Inclusion)

PART 3 – GOVERNANCE OF INFORMATION – Likert of seven points [Initial categories from Faria (2017)]

The adoption of blockchain technology in economic transactions would allow in the governance of information scope:

GI1 (AT) identify the information holder, their actions and responsibilities

GI2 (AT) to guarantee rights through policies related to transparency and prevent, for example, corruption

GI3 (AC) easy access to the information you need for your job

GI4 (AC) access to information in the appropriate format

GI5 (SH) to define, securely, information sharing policies with the market (customers and partners)

GI6 (SH) to share information between business units

GI7 (CO) that corporate information comply with internal and external regulations imposed on the institution's activities

GI8 (CO) to ensure the information confidentiality, in view of the organization's information security policies

GI9 (CM) the establishment of an internal communication process regarding information use practices

GI10 (CM) to communicate employees when they misuse information

GI11 (MN) to monitor the information use within the organization

GI12 (MN) to use metrics in order to measure information policy outcomes

GI13 (ST) the use of standards to facilitate information management

GI14 (ST) to set standards for informational records that increase agility in the organization

AT (Accountability); AC (Accessibility); SH (Sharing); CO (Compliance); CM (Communication); MN (Monitoring); ST (Standardization)

PART 4 – TRANSACTION COST – Likert of seven points [Initial categories from Williamson (1985)]

In this block, the word 'contract' will be mentioned several times, and it refers to any formalized agreement between two or more parties regarding an economic exchange or not. Knowing this, answer the questions in view of the following sentence:

The adoption of blockchain technology in economic transactions would, in the transaction costs scope, reduce:

CT1 (EC) Cost of drafting a contract (costs incurred in drafting any contract)

CT2 (NC) Contract negotiation costs (costs incurred in the period of adjustment of a contract to be signed by the economic agents, prior to its signature)

CT3 (SC) Safeguard costs (related to signaling credible commitments and transaction integrity; examples include the costs of constituting common ownership of a particular good or right that occurs until the contract is signed)

CT4 (DC) Default costs (incurred when transactions are misaligned with contractual conditions such as late delivery of a product or late payment)

CT5 (NC) Renegotiation costs (negotiation costs incurred if bilateral efforts are made to correct contractual misalignments after contract signature during the execution of the contract)

CT6 (OC) Operating costs (operating costs associated with governance structures in order to fulfill the contract in its entirety, which may include, for example, intermediary costs that are usually the trust link for the execution of various transactions)

CT7 (CC) Costs linked to credible commitments (costs to maintain liens stipulated in a contract after signing)

EC (Elaboration Costs); NC (Negotiation Costs); SC (Safeguard Costs); DC (Default Costs); NC (Negotiation Costs); OC (Operation Costs); CC (Costs linked to credible commitments).

APPENDIX B

INTERVIEW SCRIPT

Company processes product

1 – What is your main product or service?

2 – How did blockchain get into your business? How does it generate customer value?

3 – How is the company currently structured?

4 – What is the profile of your customers?

Blockchain and IG

5 – Knowing that information governance aims to guarantee the "accuracy, integrity, accessibility, and security" of information and focuses on the entire management of the total life cycle of information (Earley, 2016), do you believe that the adoption of your product/service has a positive impact on information governance? How?

6 – Do you believe that the adoption of your product/service has a positive impact on accountability? In other words, does it facilitate the identification of the information holder, their actions and responsibilities in order to guarantee rights, through policies, related to transparency and prevent, for example, corruption? How?

7 – Do you believe that the adoption of your product/service has a positive impact on information accessibility? How?

8 – Do you believe that the adoption of your product/service has a positive impact on information sharing? In other words, is it easier to define information exchange policies with the market (customers and partners) in a secure manner and to share information between business units? How?

9 – Do you believe that the adoption of your product/service has a positive impact on compliance? In other words, whether it helps ensure that corporate information complies with internal and external regulations imposed on the institution's activities and in ensuring the confidentiality of information, in view of the organization's information security policies. How?

10 – Do you believe that the adoption of your product/service has a positive impact on communication? In other words, whether it helps establish an internal communication process about practices related to the use of information and also to communicate to employees when they make improper use of the information. How?

11 – Do you believe that the adoption of your product/service has a positive impact on monitoring the use of information in the organization and the use of metrics to evaluate the results of information policies? How?

12 – Do you believe that the adoption of your product/service has a positive impact on the standardization of information, that is, on the definition of standards for informational records that increase agility in the organization? How?

Transaction cost

13 – Knowing that the transaction costs are the costs that we have to negotiate, write and guarantee the fulfillment of a contract (Fiani, 2013), do you believe that the adoption of your product/service impacts in a way to reduce the organization's expenses with transaction costs? How?

14 – Do you believe that the adoption of your product/service impacts in a way to reduce the costs of drafting a contract? How?

15 – Do you believe that the adoption of your product/service impacts in a way to reduce the contract negotiation costs (costs incurred in the period of adjustment of a contract so that it is signed by economic agents, prior to its signature)? How?

16 – Do you believe that the adoption of your product/service impacts in a way to decrease the safeguarding costs (related to the signaling of credible commitments and the integrity of the transactions. As an example, there are the costs to constitute the common property of a certain good or right that occur until the contract is signed)? How?

17 – Do you believe that the adoption of your product/service impacts in a way to decrease default costs (incurred when transactions are out of alignment with contractual conditions, such as the delay in delivering a product, or delay in payment)? How?

18 – Do you believe that the adoption of your product/service impacts in a way to lower the renegotiation costs (negotiation costs incurred if bilateral efforts are made to correct contractual misalignments after the contract is signed, during the execution of this contract)? How?

19 – Do you believe that the adoption of your product/service impacts in a way to reduce operating costs (operating costs associated with governance structures so that the contract is fulfilled in its entirety, which may include, for example, costs with intermediaries that are normally the link of trust for the execution of various transactions)? How?

20 – Do you believe that the adoption of your product/service impacts in a way to reduce costs linked to credible commitments (costs to maintain the guarantees stipulated in a contract, after its signature)? How?

APPENDIX C

CODEBOOK

The table below was elaborated according to the proposal of MacQueen et al. (1998) and presents the codes used for the content analysis carried out during Stage 4 of the thesis.

Table C1

Research codebook

Code	Code	Description	Reference
Information governance (IG) **Description:** Process that aims to ensure the accuracy, integrity, accessibility, and security of information and focuses on the entire management of the total information lifecycle (Earley, 2016)	**Accountability**	Accountability is the connection of two components: the ability to know what an actor is doing and the ability to make that actor do something else.	(Schedler, 1999; Hale, 2008)
	Accessibility	Accessibility means that information is able to be found and presented to the person who needs it, when needed, as well as in the appropriate form.	(Martin et al., 2010)
	Sharing	Sharing is the free exchange of non-confidential and sensitive information. It occurs between individuals in teams, across functional and organizational boundaries.	(Marchand et al., 2000)
	Compliance (compliance; privacy; retention; ethics)	Compliance is the duty to comply with and enforce internal and external regulations imposed on the institution's activities.	(Associação Brasileira de Bancos Internacionais, 2009)
	Communication (communication; transparency)	It refers to transferability (signals) and the transfer mechanisms between individuals, across space and over time.	(Grant, 1996)
	Monitoring	Monitoring is done to increase the amount of information available to shareholders and can alleviate agency problems when insider ownership is low.	(Anderson et al., 2007; Becher & Frye, 2011)
	Standardization	Metadata or data about data is information DNA. Consistency here will pay dividends and make compliance and auditing more efficient and less 'painful.' By standardizing foundational components, you become more agile.	(Samuelson, 2010)
Transaction cost (TC) **Description:** Those costs that we have to negotiate, write and guarantee the fulfillment of a contract (Fiani, 2013)	**Ex ante cost**	Contract drafting cost, contract negotiation costs, and safeguard costs.	(Williamson, 1985)
	Ex post cost	Default costs, renegotiation costs; operating costs and costs linked to credible commitments.	

Note. Adapted from Macqueen, McLellan, Kay, and Milstein (1998).

APPENDIX D

Table D1

Descriptive statistics

Factor	Items	Average of items	Standard deviation of items	Average of factors	Standard deviation of factors
Blockchain	BC1	6.04	1.028	5.47	1.314
	BC2	5.67	0.944		
	BC3	5.84	1.315		
	BC4	5.86	1.133		
	BC5	5.54	1.188		
	BC6	5.29	1.505		
	BC7	5.67	1.139		
	BC8	4.90	1.466		
	BC9	5.54	1.247		
	BC10	5.13	1.239		
	BC11	5.07	1.563		
	BC12	5.36	1.341		
	BC13	5.23	1.321		
	BC14	5.47	1.380		
Information governance	GI1	5.37	1.253	4.75	1.553
	GI2	5.14	1.183		
	GI3	4.14	1.497		
	GI4	4.49	1.294		
	GI5	4.99	1.546		
	GI6	5.03	1.569		
	GI7	5.06	1.541		
	GI8	5.44	1.293		
	GI9	4.29	1.264		
	GI10	3.90	1.912		
	GI11	4.46	1.954		
	GI12	4.36	1.475		
	GI13	5.00	1.362		
	GI14	4.83	1.532		
Transaction cost (perception)	CT1	5.13	1.809	5.07	1.554
	CT2	4.77	1.795		
	CT3	5.33	1.224		
	CT4	5.40	1.232		
	CT5	4.70	1.468		
	CT6	5.61	1.243		
	CT7	4.54	1.708		

Table D2

Reliability analysis and exploratory factor analysis

Cronbach's alpha		
Factor	**Cronbach's alpha**	**Quantity items**
Blockchain	0.851	14
Information governance	0.851	14
Transaction cost	0.754	7
Total	0.891	35

Kaiser-Meyer-Olkin (KMO) sample adequacy measure and Bartlett's sphericity test		
Factor	**KMO**	**Bartlett's sphericity test (Sig.)**
Blockchain	0.735	0.000
Information governance	0.724	0.000
Transaction cost	0.716	0.000

Exploratory factor analysis in block					
Items	**Blockchain (BC)**	**Items**	**Information governance (GI)**	**Items**	**Transaction cost (CT)**
BC1	0.518	**GI1**	**0.074**	CT1	0.778
BC2	**0.394**	**GI2**	**0.231**	CT2	0.877
BC3	**0.397**	**GI3**	**0.140**	**CT3**	**0.109**
BC4	0.460	GI4	0.747	**CT4**	**0.398**
BC5	0.491	GI5	0.612	CT5	0.677
BC6	0.591	GI6	0.751	CT6	0.496
BC7	0.596	GI7	0.744	CT7	0.843
BC8	0.641	**GI8**	**0.314**		
BC9	0.518	GI9	0.701		
BC10	0.608	GI10	0.824		
BC11	0.749	GI11	0.714		
BC12	0.717	GI12	0.759		
BC13	0.672	GI13	0.445		
BC14	0.665	GI14	0.737		

Table D3

Measurement model

Outer loadings, Cronbach' alpha, CR, and AVE					
Factor	Items	Outer loadings	Cronbach's alpha	CR	AVE
Blockchain	BC1	0.3	0.8	0.8	0.3
	BC2	excluded			
	BC3	excluded			
	BC4	0.3			
	BC5	0.3			
	BC6	0.3			
	BC7	0.5			
	BC8	0.6			
	BC9	0.8			
	BC10	0.5			
	BC11	0.7			
	BC12	0.8			
	BC13	0.7			
	BC14	0.7			
Information governance	GI1	excluded	0.9	0.9	0.5
	GI2	excluded			
	GI3	excluded			
	GI4	0.7			
	GI5	0.7			
	GI6	0.8			
	GI7	0.7			
	GI8	excluded			
	GI9	0.7			
	GI10	0.8			
	GI11	0.7			
	GI12	0.7			
	GI13	0.3			
	GI14	0.8			
Transaction cost	CT1	0.9	0.8	0.9	0.6
	CT2	0.9			
	CT3	excluded			
	CT4	excluded			
	CT5	0.6			
	CT6	0.4			
	CT7	0.9			

Discriminant validity — Fornell-Lacker criterion			
Factor	**Blockchain**	**Information governance**	**Transaction cost**
Blockchain	**0.574**		
Information governance	0.545	**0.755**	
Transaction cost	0.506	0.720	**0.706**

Table D4

Structural model and hypothesis testing

Collinearity test		
Factor	**VIF (factors)**	**VIF (items)**
Blockchain	-	1.594–3.857
Information governance	**1.000**	1.466–3.235
Transaction cost	**1.000**	1.147–3.435

Bootstrapping analysis

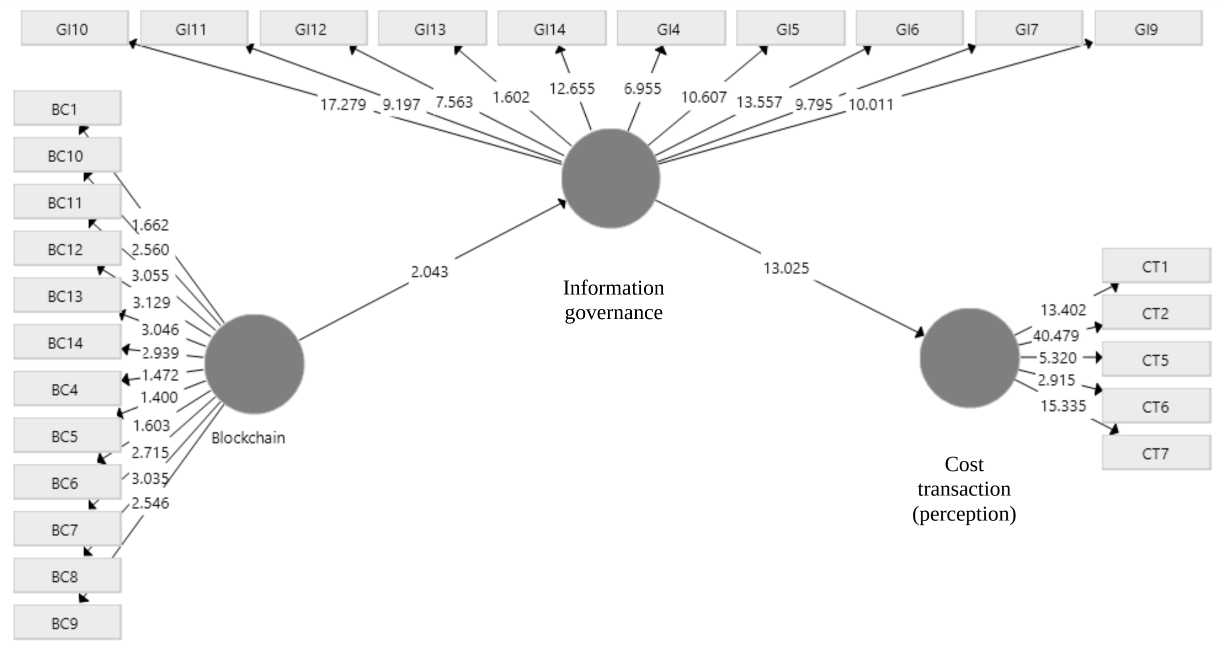

Figure D1. Model - Bootstrapping Analysis.

Table D5

Model R², Hypothesis test, Model f² and Model Q²

Model R²			
Factor	**R²**	**t-statistic**	**Sig.**
Information governance	0.519	6.462	0.000
Transaction cost	0.256	3.004	0.003

Hypothesis test					
Hypothesis	**Relation**	**Path coefficient**	**t-statistic**	**p-value**	**Status**
H1	BC -> GI	0.506	2.042	0.041	Suport
H2	GI -> CT	0.720	13.100	0.000	Suport

Model f²	
Relation	**f²**
BC -> GI	0.344
GI -> CT	1.078

Model Q²	
Factor	**Q² Stone-Geisser**
Information governance	0.275
Transaction cost	0.091

APPENDIX E

Table E1

Details of the case studies carried out

Case	Location	Product/Service focus	Customers	Type of data collected	Data analysis
Company A	Brazil	Digital identification and traceability	Europe	Interview, primary documents, secondary documents	Content analysis (Bardin, 2008)
Company B	Brazil and Europe	Digital identification and document certification and authentication	South America and Europe		
Company C	Europe	Social financing	Europe		

Table E2

Detailing of data collection in the three case studies carried out

Case	Data collection type*	Description
Company A	Interviews	Managers responsible for the marketing, financial, and commercial sectors
	Primary documents	Posts on the website and social networks; company's internal documents (example: project presentations)
	Secondary documents	Interviews given by company members to the various media (videos and texts)
Company B	Interviews	Company owner/manager
	Primary documents	Posts on the website, social networks, Telegram group
	Secondary documents	Interviews given by company members to the various media (videos and texts)
Company C	Interviews	Project director
	Primary documents	Website posts and social media
	Secondary documents	Interviews given by company members to the various media (videos and texts)

Note. * Categorized based on Lakatos and Marconi (2010).

APPENDIX F

Analysis of the word frequency of the data collected in each analyzed case

Company A

Figure F1 highlights the main terms found in the data analysis in relation to the influence of the adoption of Company A's technology and its influence on information governance and transactional costs. The data used to generate this cloud were all text extracts encoded in the information governance and transactional costs nodes of Company A.

Figure F1. Word cloud — Company A code.
Words: Blockchain (Blockchain); Tecnologia (Technology); Dados (Data); Identidade (Identity); Identificação (Identification); Processo (Process); Pessoa (Person); Solução (Solution); Segurança (Security): Digital (Digital).

The words in Figure F1 highlight Company A's main service, which is the digital identity solution through blockchain technology, that allows for simplification of processes and greater security of the parts of a transaction when carrying out various actions using the platform developed by Company A. Using the primary documents analyzed, the identification process allowed by company A's solution reduces bureaucracies, making it more agile and bringing security and autonomy to its users. In other words, the solution allows simplifying the identification of people in a safe and fraud-proof way, as disclosed by the company on its blog.

Still on Figure F1, the word 'process' is identified, which is related to the traceability solution from Company A's blockchain, which is adaptable to any process that the client wants to track and, according to information provided by the respondents and the documents analyzed, each step is recorded through an application or web application, which can be accessed by reading a QR code, for example. This solution allows the user, when accessing the information, to guarantee the immutability of the data, thus preventing fraud.

Company B

Figure F2 highlights the main terms found in the data analysis in relation to the influence of the adoption of this company's technology and its influence on information governance and transactional costs. The data used to generate this cloud were all text extracts encoded in the information governance and transactional costs nodes of Company B.

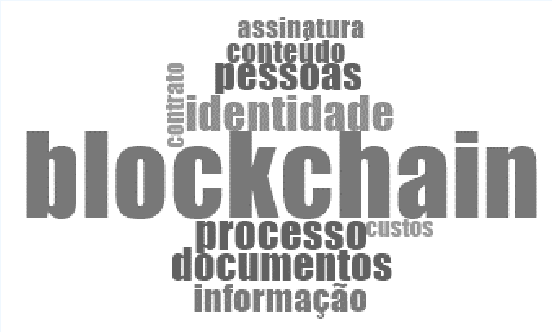

Figure F2. Word cloud — Company B code

Words: Blockchain (Blockchain); Identidade (Identity); Contrato (Contract); Pessoas (People); Conteúdo (Content); Assinatura (Signature); Processo (Process); Custos (Costs); Documentos (Documents); Informação (Information).

The words in Figure F2 highlight the digital signature solutions offered by Company B, for signing contracts and other documents. In addition, it already highlights some topics that are often mentioned in all the analyzed documents, which is the use of Company B's services to record evidence in legal proceedings and how this brings legal certainty to those who use this solution. The highlight is how the services of this company help reduce costs by simplifying processes. Finally, the mention of 'people' and 'identity' in the word cloud stands out, which are related to the digital identity service, that has two focuses: legal entities and individuals.

Company C

Figure F3 highlights the main terms found in the data analysis regarding the influence of the adoption of this company's technology and its importance to information governance and transactional costs. The data used to generate this cloud were all text extracts encoded in the information governance and transactional costs nodes of Company C.

Figure F3. Word cloud — Company C code.

Words: Projetos (Projects); Impacto (Impact); Organizações (Organization); Social (Social); Custos (Costs); Dados (Data); Sociais (Social); Investidores (Investors); Investimento (Investment); Dinheiro (Money).

The words in Figure F3 highlight the entire environment related to Company C's solution that is connected to social impact projects. In this sense, the company's platform seeks to be an environment that promotes investments in social issues through transparency.

Something important to mention here is that Company C's platform allows both the donation from individuals for projects and the operationalization of impact investments, which are investments made in companies, organizations, and funds with the objective of generating a measurable social impact, along with a financial return. The focus is to generate transparency and more information on the impacts of each project to encourage more investors and enable an improvement in the execution of the projects using the knowledge of which practices work for a given objective and which are not as effective.

APPENDIX G

Summary of research gaps, their contributions, implications, and suggestions for future studies

Table G1

Summary of final considerations

Research gaps		Contributions	Implications	Future studies
A "comprehensive understanding of application terms and use cases" is needed (Risius & Spohrer, 2017, p. 390) It is understood to be relevant to explore the impact of using blockchain on business, considering the consequences that its use can bring to contemporary business processes and models (Avital et al., 2016; Beck et al. 2016; Lindman et al., 2017) There are only a few studies and contributions about the disruptive potential of blockchain technology that cross the domains of IT (Beck & Müller-Bloch, 2017) and focus on a broader approach	More comprehensive understanding of use cases for this technology in business and its impact	Description of the use of blockchain technology in three distinct cases, highlighting their characteristics and value propositions in these organizations	Examples of concrete use of blockchain technology, illustrating business models that use it	Explore more organizations that use blockchain in their business models and analyze how much that use ends up distributing operations
In order to move forward with the dissemination of this technology, "research should investigate the costs and benefits of blockchain, and not just focus on improving ease of use" (Risius & Spohrer, 2017, p. 401)	Blockchain costs and benefits	Evidence of how Blockchain adoption impacts Transaction Costs Reflection on how new technologies may be affecting the theoretical body of transaction cost theory, evidence drawn from blockchain technology	Blockchain reduces transaction costs Reduces the impact of behavioral assumptions, allowing greater decentralization of operations	Identify the new types of business governance structures that arise from the use of blockchain
Analyze how blockchain technology can serve as a mechanism that provides information to support quality and protection of opportunistic behaviors, which is essential in the current information scenario in which information is a resource of great importance for organizations (Rasouli, Eshuis, Grefen, Trienekens, & Kusters, 2017)	Impact of blockchain on information governance	Evidence that blockchain can be viewed as an information governance mechanism	Blockchain is an information governance mechanism	Identify which types of operations benefit most from the use of blockchain in the perspective of IG improvement