FutureJournal

FUTURE STUDIES RESEARCH JOURNAL: RENDS AND STRATEGIES

Future Studies Research Journal - Fia Business School
Scientifc Editor: Renata Giovinazzo Spers
Evaluation: Double Blind Review, pelo SEER/OJS
Review: Preliminary
Doi:https://doi.org/10.24023/FutureJournal/2175-5825/2020.v12i2.498

How Blockchain Affects the Technological Strategy of the Financial Industry: An Analysis Based on Knowledge Discovery in Text

Received: 10/11/2019

Approved: 15/02/2020

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Abstract

Purpose – The main objective of this article is to investigate how blockchain is affecting the technological strategy of the financial industry.
Theoretical framework – Our theoretical framework is structured based on four approaches: Blockchain; Blockchain Advantages; Technology Strategy; Blockchain Technology Strategy.

Design/methodology/approach – We conducted an exploratory study using knowledge discovery in texts (KDT), with the support of text mining tools. We collected and analyzed contents of a set of news published on the Web about Blockchain. A total of 2,605 blockchain web news items were extracted from the business media worldwide, such as Forbes, Fortune, Financial Post and Business World. We explored the text dataset using sentiment analysis, opinion mining, text association analysis, and correspondence analysis.

Findings – The results showed that blockchain technology has the potential to affect the transactions through a common platform. Additionally, the results demonstrated the advantages of blockchain technology for cross-border payment systems.

Research, Practical & Social implications – We elaborate four theoretical propositions that may guide research and help practitioners to identify challenges and opportunities for blockchain technology.

Originality/value – Our study revealed how blockchain has been affecting the technology strategy of the financial industry and highlighted two starting trajectories: the establishment of private blockchain and its application in the cross-border payment services.

Keywords: Technology Strategy. Blockchain. Financial Industry. Knowledge Discovery in Text. Text Mining.

How to cite the article:

Fernandes, M., & Verschoore, J. (2020). How Blockchain Affects the Technological Strategy of the Financial Industry: An Analysis Based on Knowledge Discovery in Text. Future Studies Research Journal: Trends and Strategies, 12(2), 311-334. doi:https://doi.org/10.24023/FutureJournal/2175-5825/2020.v12i2.498

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Como o Blockchain Afeta a Estratégia Tecnológica da Indústria Financeira: uma Análise Baseada na Descoberta de Conhecimento em Texto

Resumo

Objetivo do estudo – O principal objetivo deste artigo é investigar como o blockchain está afetando a estratégia tecnológica do setor financeiro.

Metodologia/abordagem – Realizamos um estudo exploratório utilizando a descoberta de conhecimento em textos (DCT), com o apoio de ferramentas de mineração de textos. Coletamos e analisamos o conteúdo de um conjunto de notícias publicadas na Web sobre o Blockchain. Um total de 2.605 notícias sobre blockchain foi extraído de revistas de todo o mundo, como Forbes, Fortune, Financial Post e Business World. Exploramos este conjunto de dados de texto usando análise de sentimentos, mineração de opinião, análise de associação de texto e análise de correspondência.

Originalidade/Relevância – Nosso estudo revelou como o blockchain está afetando a estratégia tecnológica do setor financeiro e destacou duas trajetórias iniciais: o estabelecimento do blockchain privado e sua aplicação nos serviços de pagamento internacionais.

Principais resultados – Os resultados demostraram que a tecnologia blockchain tem o potencial de afetar as transações por meio de uma plataforma comum. Além disso, os resultados demonstraram as vantagens da tecnologia blockchain para sistemas de pagamento internacionais.

Contribuições teóricas/metodológicas – Elaboramos quatro proposições teóricas que podem orientar a pesquisa e ajudar os profissionais a identificar desafios e oportunidades para a tecnologia blockchain.

Palavras-chave: Estratégia Tecnológica; Blockchain. Indústria Financeira. Descoberta de Conhecimento em Texto. Mineração de Texto.

Como Citar:

Fernandes, M., & Verschoore, J. (2020). How Blockchain Affects the Technological Strategy of the Financial Industry: An Analysis Based on Knowledge Discovery in Text. Future Studies Research Journal: Trends and Strategies [FSRJ], 12(2), 311-334. doi:https://doi.org/10.24023/FutureJournal/2175-5825/2020.v12i2.498

1 INTRODUCTION

At the height of the financial crisis of 2008, an article published by Nakamoto (2008) laid the groundwork for what came to be known as the bitcoin cryptocurrency. Bitcoin and the cryptocurrencies that emerged afterwards represented a disruption in the logic of financial operations. Unlike currencies minted and guaranteed by nation-states, such as the dollar or the yen, bitcoin is technologically supported (Carrick, 2016). Transactions in bitcoins are recorded in a universal ledger that is open and distributed to be visible to all. Transactions are stored in blocks, with each block linked chronologically and cryptographically to those that precede it to create an unchangeable and tamper-resistant record. Transactions are marked with their respective time in order to provide a record of when the transactions occurred and in what order, which protects against double spending and tampering with prior transaction records. When a block is accepted by the network and added to the chain, it cannot be changed, and it becomes a permanent, transparent and unchangeable record of the transactions. The distributed ledger is called a blockchain (Mougayar, 2016).

Blockchain technology has affected transactions and relationships among companies. Companies can use blockchain to securely gather private data into a shared neutral system rather than keep it locked inside internal systems. In blockchains, the assurance of reliability does not occur through intermediaries, such as governments and banks, but through decentralized cryptographic technologies (Mougayar, 2016). With blockchain, each stakeholder can track the status of a transaction and know what is happening. In the case of bitcoin, the process occurs so that a transaction can be added to the blockchain only when it includes a solution to a specific mathematical problem. These mathematical problems are designed to be computationally difficult and time-consuming to solve, but simple to verify. Falsification of transactional information in the blockchain is, therefore, very difficult because it is too costly to rewrite the history (Halaburda, 2018).

Technological innovations provide opportunities for the emergence of new products, services and processes. Technology strategy has the role of integrating these opportunities into the objectives of business units in a coherent way (Ford, 1988). Furthermore, foundational technology, such as blockchain, has the potential to break away from the foundations of economic and social systems, instituting new realities (Iansiti & Lakhani, 2017). Foundational technologies force companies to rethink their entire business. These technologies are quickly adopted in corporate discourse but are not always incorporated in strategies. To a great extent, the distance between

discourse and strategy stems from the managerial and cultural challenges that managers cannot overcome. Blockchain itself has technical and managerial limitations that need to be overcome (Yli-Huumo et al., 2016). The literature review by Lindman et al. (2017) pointed out gaps in knowledge about the decentralized systems of blockchain. The decentralization proposed by blockchain, therefore, has not yet been consolidated in companies' technology strategies (Neyer & Geva 2017).

This distance between the discourse about blockchain importance and its effective implementation in companies' strategies raises questions. In which industries is blockchain impacting business? How does blockchain affect technological strategies? How blockchain technology has been included into corporate strategies? Such questions are directly related to the financial industry.

Financial services are rapidly being affected by digital assets, digital currencies, and digital record-keeping based on blockchain. Moreover, financial companies benefit from faster payments and reduction in the settlement period (Lewis et al., 2017). The financial industry has an appropriate context for blockchain innovation, which motivated the delimitation of this study. Therefore, the main objective of this article is to investigate how blockchain is affecting the technological strategies of the financial industry.

To do so, we conducted an exploratory study using the knowledge discovery in texts analysis with the support of text mining tools. We chose this approach because of the great mass of information about the phenomenon present in the news published on the Internet. We were able to collect a database of 2,605 news published worldwide from 2015 to 2017. This database allowed us to run quantitative analysis covering the association among terms and positive or negative feelings about them.

The key contribution of the article is threefold: 1) the article maps the recent inclusion of blockchain technology in the financial industry strategies; 2) the article outlines a set of propositions that point out how company strategies are transformed by blockchain technology, emphasizing the foresight process of the industry practitioners; and 3) the results guide studies on the relationship between blockchain technology and corporate strategies, laying the foundation for more objective conclusions in the future. Our findings revealed how blockchain has been affecting the technology strategy of the financial industry and highlighted two starting trajectories: the establishment of private blockchain and its application in the cross-border payment services.

2 LITERATURE REVIEW

Over the last two decades, banking and financial service technologies have evolved rapidly as a result of the expansion of the Internet (Costanzo, 2004). Recently, the financial industry was surprised by startups that emerged as beginners in markets that were hitherto dominated by established companies (Gabor & Brooks 2017; Li et al., 2017). These startups, which are based on technological advantages, arise by proposing digital business models, which seek to widen disintermediation and transform the supply of financial services (Dhar & Stein 2017). One of the main disruptive technologies of financial startups is the blockchain (Carrick, 2016).

In the last twenty years, advances in the fields of cryptography and decentralized computer networks have resulted in the emergence of blockchain (Mougayar, 2016). Blockchain is an open, shared and distributed ledger that can record transactions among parties in a verifiable and permanent way (Iansiti & Lakhani 2017). Blockchain enables unrelated parties to reach consensus on the occurrence of a particular transaction or event without the need for a controlling authority. Blockchain follows the principles that were employed upon creating bitcoin, operating in a distributed manner without a central database that may be jeopardized. The network is public, and anyone can view it at any time. There is no third party responsible for conducting transaction audits and maintaining records (Mougayar, 2016).

Blockchain uses encryption involving public and private keys, such as the two-key system, in order to maintain virtual security. The solution is not new. In fact, it is a solution to the problem that is widely discussed and known in computer science as the Byzantine Generals Problem (Lamport et al., 1982). From this starting point, the technological solution of the blockchain seeks to make feasible the transactions in which the participants do not trust each other, and the reconciliation of contradictory ledgers is costly. Blockchain provides security, but at the same time, recording transactions on a shared ledger is costly and takes longer than on a centralized ledger because of the consensus mechanisms (Halaburda, 2018).

As a result, blockchain and the underlying distributed database technologies are the major inflection points of recent developments in distributed transaction systems. According to Iansiti and Lakhani (2017) blockchain reduces the cost of transactions and has the potential to become the record technology for all transactions, such as legal and public records, including titles, birth certificates, and voting or court records. Blockchain can also be applied to the creation of smart property, in which case the blockchain becomes an inventory, performs the tracking and serves as a buying and selling mechanism for durable assets, such as diamonds or cars (Iansiti & Lakhani

2017). According to Mainelli and Smith (2015), blockchain can still be applied as a transactional mechanism for services of the sharing economy, since it solves the reliable recording of activities on a large scale.

In summary, the advantage of blockchain derives directly from three factors and the way these factors interact with each other: the distributed nature of the ledger, which generates transparency and synchronization; the consensus protocol, which nullifies the need for trust; and the way data is written, stored and connected, which produces immutability and traceability. However, the growth and adoption of blockchain also depends on the structuring of an ecosystem (Kabashkin, 2017). Blockchain has overcome its complexity and, to that end, its applications depend on developers, entrepreneurs, managers, investors and, above all, adopters to establish themselves as the technological mainstream for transactions. Blockchain has been gradually incorporated into corporate discourse. In some industries, the discourse has not affected the technological strategies of companies, while in other industries, blockchain has already begun to be used in commercial applications (Mougayar, 2016).

The financial industry, which is motivated by digital innovations, is one industry that has the potential to benefit from blockchain due to the reduction in the settlement period and the acceleration of payment processes (Lewis et al., 2017). The adoption of blockchain in financial services may also prevent adverse behavior and repercussions, such as double spending, forgery and false disputes (Barber et al., 2012). Scholars indicate that blockchain can even lead to changes in corporate governance through lower costs, greater liquidity, more accurate record-keeping, and transparency of ownership (Yermack, 2017).

Studies in the financial field indicate that blockchain can be particularly effective in improving interbank payments remittances, more specifically for the banking correspondents, business-to-business payments and peer-to-peer remittances (de Meijer, 2016). According to Guo and Liang (2016), interbank payments depend on processing by clearing broker firms, which involves a number of complex processes, including bookkeeping, transaction reconciliation, reconciliation of balances, and initiation of payments. Therefore, a cross-border shipment takes almost 3 days to reach the destination. However, gains from the introduction of blockchain may not be readily available because the underlying processes also need to be rethought and redesigned (Ali et al., 2014).

Specifically, regarding digital payments, trust between the parties is a challenge that can be overcome by blockchain (Shaw, 2014). The trajectory of mobile payments has pointed to the need for a reliable service manager to manage authentication,

authorization and account settlement (Ondrus & Pigneur, 2009), especially in the presence of direct and indirect network effects, as described by Au and Kauffman (2008). Nonetheless, studies in emerging markets showed that blockchain and cryptocurrencies have characteristics that make them well suited to work with complementary currencies without the need for intermediaries, which minimizes the risk of their adoption as a form of payment (Carrick, 2016).

Blockchain technology, like any other technological development, imposes strategic challenges on companies. Opportunities are created, products have their lifecycles reduced, and markets are restructured. To address these challenges, companies rely on technology strategies. According to Ford (1988), technology strategy consists of policies, plans and procedures to acquire knowledge and skills, managing them within a company, and exploiting them in order to obtain the highest possible return. The essence of technology strategy lies in the knowledge and skills that it has available (Husain, 2016).

Technology strategies involve the appropriate means of technological development, ranging from minor or major integrations, the use of the R & D team itself, the establishment of joint research contracts, and the use of licensing (Clarke et al., 1995). In addition, strategic decisions require an analysis of which technologies a company needs to invest its resources in, not only individually but also as part of its portfolio of technologies (Clarke et al., 1995; von der Gracht et al., 2010). Through technology strategies, companies and industries are able to assess the implications of new technologies and proactively act to lay the foundations of a future competitive advantage (Rohrbeck et al., 2015). To do so, companies assess the implications of present actions, detect problems before they occur, and consider the present implications of future events (Slaughter, 1995). The potential of technology strategy approach is particularly acknowledged in high-technology markets, such as the financial industry, in which innovation is a continuous and contextual practice of 'wayfinding' (Sarpong et al., 2015).

Nevertheless, blockchain is a foundational technology (Iansiti & Lakhani, 2017) that requires broad strategies to deal with new realities that may arise. Therefore, blockchain-based technology strategies consider the effects of blockchain applications on the organizational structure, mode of operation and business management models (Yoo, 2017). In addition, some scholars argue that blockchain strategy for companies must take into account the capabilities this technology brings and the problems it can solve for stakeholders (Felin & Lakhani, 2018). However, systematic literature reviews indicated that blockchain applications, beyond bitcoin and other cryptocurrency

systems, remains under-theorized (Yli-Huumo et al., 2016) and that mechanisms through which blockchain affects corporate efficiency require further academic inquiry (Xu et al., 2019). These theoretical gaps have stimulated our study. Based on the four approaches summarized in Table 1, subsequent sections will investigate how blockchain is affecting the technological strategies of the financial industry.

Table 1 - Theoretical Framework

Approaches	Description	References
Blockchain	Blockchain is an open, shared and distributed ledger that can record transactions among parties in a verifiable and permanent way.	Mougayar (2016) Iansiti and Lakhani (2017) Halaburda (2018)
Blockchain Advantages	The main advantages of blockchain are: 1) the distributed nature of the ledger, which generates transparency and synchronization; 2) the consensus protocol, which nullifies the need for trust; and, 3) the way data is written, stored and connected, which produces immutability and traceability.	Shaw (2014) de Meijer (2016) Carrick (2016) Lewis et al. (2017) Yermack (2017)
Technology Strategy	Technology strategy consists of policies, plans and procedures to acquire knowledge and skills, managing them within a company, and exploiting them to obtain the highest possible return.	Ford (1988) Clarke et al. (1995) Rohrbeck et al. (2015) Husain (2016)
Blockchain Technology Strategy	The effects of blockchain technology on the organizational structure, mode of operation and business management models. It takes into account the capabilities this technology brings and the problems it can solve for stakeholders.	Iansiti and Lakhani (2017) Yoo (2017) Felin and Lakhani (2018)

Source: Author's own elaboration.

The next section provides more details about the methodology and the knowledge discovery in texts analysis.

3 METHODOLOGY

For this article, exploratory research with a quantitative approach was carried out using techniques of knowledge discovery in texts. Knowledge discovery in texts deals with unstructured data, such as texts, which are considered the most natural form of information storage (Tan, 1999). The knowledge discovery in texts was initially proposed by Feldman and Dagan (1995) to describe the process of finding important information in large collections of texts. The text mining or text data mining (Tan, 1999) are also used as synonyms for knowledge discovery in texts. It is important to mention that the choice of this process occurred by facing the great existence of unstructured data about blockchain in news and websites.

A web-based data collection was performed in two phases. The first phase consisted of research, through a news search tool, for news about the blockchain

subject and the extraction of its Uniform Resource Locator (URL). The second phase consisted of extracting texts from the news by using Web Crawler software, followed by checking the extracted data. News items were surveyed from January 1, 2015, through December 31, 2017. This period was chosen for representing the growth peak of interest in blockchain as indicated by the Google Trends tool. Data for each year were collected separately. In addition, search rules were set up to remove duplication of news. The initial period of this research was chosen based on an analysis performed through the Google Trends tool, by which it was detected that the subject began to have a significant increase of searches on the Web in the year 2015. The data collection resulted in a database formed of 466 files, containing a total of 2,605 news items, all in English, on the subject of blockchain.

Different quantitative analysis techniques were adopted in this database. Absolute and relative frequencies were used to identify the most frequent terms. In addition, word clouds were made to analyze the news in general. Word clouds are a means of representing the frequency that words appear in a text, so that the larger and darker the word is in the figure, the greater is the frequency of the word (Fellows, 2012). A comparison cloud (Fellows, 2012) was used to evaluate the words in relation to the years of news publication. A comparison cloud contrasts terms with higher usage frequencies in different groups, showing different perceptions by group.

To complement the results, a correspondence analysis was performed to construct perceptual maps (Tan et al., 2005). Correspondence analysis reduce the information contained in several original variables into a smaller set of combined variables (dimensions) with minimal information loss. It makes possible to study the correspondence between the variables. The choice made by correspondence analysis allows the inclusion of categorical variables, which are appropriate for nominal data. To identify the relation between the terms, an association analysis was performed. According to Tan et al. (2005), the association analysis is useful for discovering interesting relationships hidden in large data sets. The uncovered relationships can be represented in the form of association rules or sets of frequent items. To evaluate the perception of the news about the main subject, a sentiment analysis was used. According to Liu (2010), sentiment analysis, or opinion mining, is the computational study of opinions, feelings and emotions expressed in text. Sentiment analysis essentially tries to infer people's feelings based on their linguistic expressions. It is an active field of research in natural language processing, and it is extensively studied in data mining, web mining and text mining (Liu, 2010).

To group similar texts and words together, a hierarchical clustering analysis was performed using Ward's method and Euclidian distance (Hair et al., 2009). Hierarchical algorithms are divided into agglomerative and divisive types. In the agglomerative method, each object is initially considered to be distinct from all others, that is, the initial number of clusters is equal to the number of objects. Then, objects that have smaller distance or greater similarity are grouped together gradually until only one group is formed, which contains all the objects. Ward's method seeks to form groups to always achieve the smallest degree of internal error between the vectors that make up each group and the average group vector, that is, the method searches for the least standard deviation between the data of each group. Furthermore, Ward's method uses as a distance the sum of the squares between two clusters, which is performed with all variables. The method forms groups to minimize the internal sum of squares, which is equivalent to searching for the minimum standard deviation among the data of each group.

4 RESULTS

In all, 2,605 news items were analyzed, which generated 1,158,304 different terms. Among these terms, blockchain, technology, bitcoin, bank and transaction were the most frequent terms. Together, these terms represent 6.26% of the terms used in all of the texts.

Furthermore, the term blockchain was widely used in all of the texts, being used 2.43 times more frequently than the second most frequent term, which was technology. Table 2 presents the most frequent news terms in the years from 2015 through 2017.

Table 2 –The most frequently used terms in the years surveyed

Term	N	%	Term	N	%
blockchain	32184	2.79%	network	3360	0.29%
technology	13221	1.15%	time	3223	0.28%
bitcoin	12438	1.08%	world	3088	0.27%
bank	7332	0.64%	industry	3050	0.26%
transaction	7025	0.61%	business	3043	0.26%
company	6474	0.56%	currency	2908	0.25%
new	6009	0.52%	first	2868	0.25%
financial	5632	0.49%	distributed	2864	0.25%
system	5250	0.46%	using	2801	0.24%
digital	4925	0.43%	platform	2790	0.24%
service	4348	0.38%	money	2655	0.23%
data	4309	0.37%	way	2601	0.23%
based	3653	0.32%	many	2588	0.22%
ledger	3524	0.31%	people	2574	0.22%
year	3516	0.30%	market	2560	0.22%
payment	3461	0.30%	now	2395	0.21%
use	3389	0.29%	just	2331	0.20%
like	3378	0.29%	smart	2257	0.20%

Source: Author's own elaboration.

The results were also analyzed according to the year in which the news was published. The analysis made it possible to observe the evolution of the frequency of annual terms and to make comparisons among the periods. Table 3 presents the 25 most frequently used terms in each year that was studied.

Table 3 – The most frequently used terms for each year

2015			2016			2017		
Term	**N**	**%**	**Term**	**N**	**%**	**Term**	**N**	**%**
blockchain	9359	2.33%	blockchain	10923	3.16%	blockchain	11902	2.93%
bitcoin	6111	1.52%	technology	4689	1.36%	technology	4334	1.07%
technology	4198	1.05%	bitcoin	3187	0,92%	bitcoin	3140	0.77%
bank	2598	0.65%	bank	2596	0,75%	company	2616	0.64%
transaction	2563	0.64%	transaction	2205	0,64%	transaction	2257	0.56%
new	2085	0.52%	financial	2158	0,62%	new	2218	0.55%
company	2059	0.51%	company	1799	0,52%	bank	2138	0.53%
financial	2028	0.50%	new	1706	0,49%	data	1769	0.44%
system	1916	0.48%	system	1677	0,49%	system	1657	0.41%
digital	1692	0.42%	digital	1668	0,48%	digital	1565	0.39%
service	1485	0.37%	service	1633	0,47%	financial	1446	0.36%
payment	1296	0.32%	data	1272	0,37%	based	1417	0.35%
like	1295	0.32%	ledger	1249	0,36%	year	1315	0.32%
use	1269	0.32%	based	1164	0,34%	network	1262	0.31%
data	1268	0.32%	payment	1156	0,33%	service	1230	0.30%
year	1174	0.29%	distributed	1137	0,33%	like	1169	0.29%
currency	1170	0.29%	industry	1103	0,32%	time	1160	0.29%
ledger	1146	0.29%	business	1077	0,31%	use	1133	0.28%
time	1137	0.28%	year	1027	0,30%	ledger	1129	0.28%
network	1125	0.28%	use	987	0,29%	platform	1096	0.27%
world	1073	0.27%	network	973	0,28%	ethereum	1095	0.27%
based	1072	0.27%	world	971	0,28%	business	1087	0.27%
using	1060	0.26%	time	926	0,27%	market	1045	0.26%
people	1051	0.26%	like	914	0,26%	world	1044	0.26%
way	1038	0.26%	platform	908	0,26%	industry	1029	0.25%

Source: Author's own elaboration.

In 2015, 401,594 terms were found; in 2016, 345,745 terms were found; and in 2017, 405,734 terms were found. The results indicate that the most frequently used terms were similar throughout the 3 years. The terms currency, payment, and people are among the most frequently used in 2015, and they do not appear among the most frequently used in 2016 and 2017. The terms business, industry and platform are among the most frequently used in the years 2016 and 2017, and they had not been identified among the most frequently used terms in the year 2015. The term ethereum is not listed among the most frequently used terms in 2015 and 2016, but it is identified in 2017. Figure 1 shows the perceptual map of the relation between the most frequently used terms and the years of publication. These results express the percentage of the total variability of the original variables that the combined variables (dimensions) explains. Dimension 1 (Dim1) explains 72.1% of the variability of the original variables and dimension 2 (Dim2) explains 27.9% of the variability of the original variables. The closeness of the terms relative to the 3 years included in this study indicates the relational intensity.

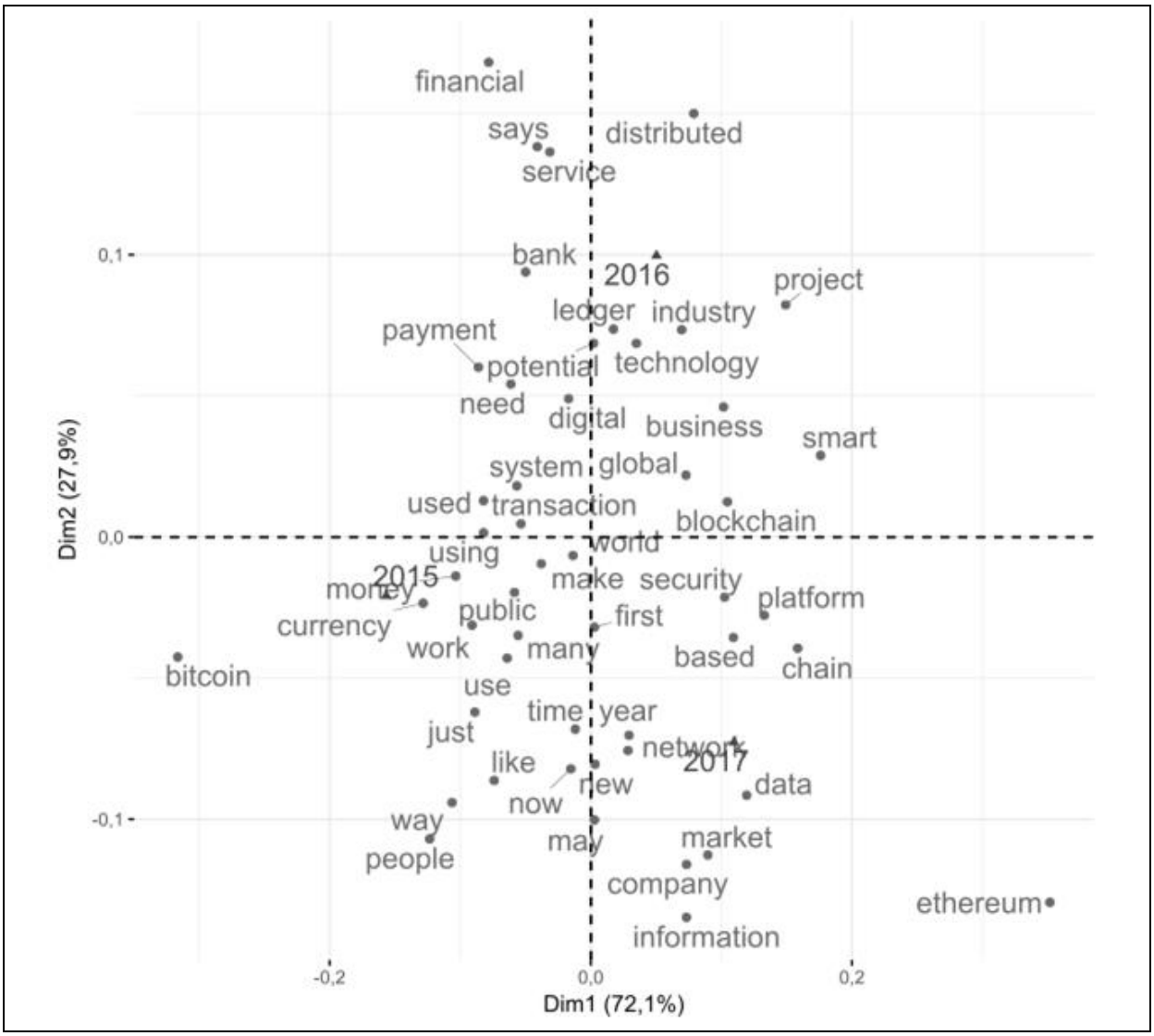

Figure 1 – Perceptual map of terms per year

Source: Author's own elaboration.

In the association analysis, the results indicated relationships among the 42 main terms found. Values between 0 and 1 indicate the strength of association between the terms. If two terms are used together in 100% of the texts, the association will be 1, and if two terms are used together in 50% of the texts, the association will be 0.5. To identify the most relevant associations, a minimum correlation limit of 0.70 was adopted. In this study, associations greater than 0.90 were considered high. Table 4 presents the analysis of association among the most frequently used terms.

Table 4 – Association analysis among the most frequently used terms

Terms	*blockchain*	technology	bitcoin	bank	transaction	company	new	financial	system	digital
bank	0.84	0.89	0.75	-	0.79	0.78	0.81	0.90	0.85	0.83
based	**0.94**	**0.93**	0.83	0.84	0.88	0.90	0.89	0.88	**0.91**	**0.91**
bitcoin	0.84	0.87	-	0.75	0.87	0.83	0.86	0.86	0.89	0.90
blockchain	-	**0.96**	0.84	0.84	0.89	**0.91**	**0.93**	0.90	**0.92**	**0.91**
business	**0.93**	**0.91**	0.79	0.77	0,81	0.88	0.87	0.84	0.86	0.86
company	**0.91**	**0.91**	0.83	0.78	0.82	-	0.89	0.86	0.88	0.89
currency	0.88	0.90	**0.91**	0.84	0.87	0.86	0.89	0.89	**0.91**	**0.94**
data	0.87	0.83	0.76	0.72	0.85	0.84	0.80	0.79	0.87	0.83
digital	**0.91**	**0.93**	0.90	0.83	0.88	0.89	**0.91**	**0.92**	**0.94**	-
distributed	0.86	0.86	0.70	0.81	0.82	0.72	0.81	0.83	0.84	0.81
even	0.87	0.82	0.85	0.70	0.82	0.82	0.81	0.77	0.86	0.83
financial	0.90	**0.95**	0.86	0.90	0.86	0.86	0.88	-	**0.92**	**0.92**
first	**0.93**	**0.93**	0.88	0.83	0.85	0.90	**0.91**	0.87	0.90	0.89
industry	**0.91**	**0.93**	0.76	0.83	0.80	0.85	0.88	0.89	0.86	0.85
just	0.85	0.82	0.80	0.73	0.77	0.79	0.79	0.74	0.81	0.77
ledger	0.88	0.89	0.75	0.86	0.87	0.79	0.83	0.86	0.88	0.85
like	0.86	0.83	0.85	0.71	0.83	0.83	0.80	0.78	0.86	0.82
make	0.89	0.89	0.87	0.77	0.84	0.86	0.85	0.83	0.90	0.86
many	0.87	0.87	0.84	0.74	0.80	0.86	0.83	0.83	0.88	0.85
market	0.88	0.87	0.77	0.77	0.78	**0.91**	0.85	0.83	0.85	0.85
may	0.89	087	0.78	0.75	0.83	0.86	0.86	0.82	0.85	0.83
money	0.83	0.83	0.83	0.75	0.81	0.80	0.80	0.80	0.86	0.85
need	0.86	0.85	0.82	0.76	0.82	0.80	0.81	0.81	0.85	0.83
network	0.90	0.89	0.85	0.78	0.89	0.89	0.88	0.86	**0.91**	0.90
new	**0.93**	**0.92**	0.86	0.81	0.83	0.89	-	0.88	0.90	**0.91**
now	0.90	0.86	085	0.77	0.85	0.86	0.83	0.80	0.87	0.85
payment	0.83	0.86	0.77	0.84	0.78	0.81	0.80	0.88	0.85	0.83
people	0.81	0.79	0.85	0.65	0.77	0.79	0.77	0.72	0.81	0.80
potential	**0.91**	**0.92**	0.80	0.83	0.81	0.85	**0.92**	0.89	0.85	0.87
service	**0.91**	**0.93**	0.85	0.81	0.82	0.90	0.88	**0.92**	0.90	0.90
system	**0.92**	**0.93**	0.89	0.85	**0.91**	0.88	0.90	**0.92**	-	**0.94**
technology	**0.96**	-	0.87	0.89	0.87	**0.91**	**0.92**	**0.95**	**0.93**	**0.93**
time	**0.92**	0.90	0.85	0.84	0.87	0.87	0.90	0.86	0.90	0.88
transaction	0.89	0.87	0.87	0.79	0.87	0.82	0.83	0.86	**0.91**	0.88
use	**0.94**	**0.95**	0.88	0.85	-	0.90	**0.91**	**0.91**	**0.93**	0.90
used	0.90	0.90	0.87	0.81	0.88	0.86	0.86	0.87	**0.92**	0.89
using	0.88	0.89	0.86	0.83	0.88	0.88	0.85	0.88	**0.92**	0.90
way	0.89	0.86	0.84	0.76	0.83	0.87	0.88	0.81	0.89	0.86
well	**0.92**	0.90	0.84	0.79	0.81	0.89	0.86	0.86	0.89	0.85
work	0.87	0.85	0.87	0.75	0.84	0.85	0.89	0.82	0.88	0.86
world	**0.93**	**0.93**	0.89	0.81	0.87	0.90	0.88	0.90	**0.92**	**0.91**
year	**0.94**	**0.93**	0.82	0.87	0.81	0.90	**0.93**	0.88	0.89	0.89

Source: Author's own elaboration.

Among the results, it is worth noting that the term blockchain has a strong association with the terms based, business, company, digital, first, industry, new, potential, service, system, technology, time, use, well, world, and year. The term

technology has a high degree of association with business, digital, financial, first, industry, new, potential, service, system, use, world and year. The term bitcoin was highly associated with currency.

Finally, the sentiment analysis was conducted based on the terms and expressions predefined as positive feelings and negative feelings by Liu (2010). The results of the 25 most frequently used terms of positive and negative feelings are presented in Table 5.

Table 5 – Most frequently used terms of positive and negative feelings

Positive Feelings	N	%	Negative Feelings	N	%
work	2603	4.77%	problem	1376	4.91%
well	1667	3.05%	issues	1165	4.15%
secure	1463	2.68%	risk	1151	4.10%
trust	1251	2.29%	fraud	496	1.77%
innovation	1168	2.14%	hard	491	1.75%
popular	971	1.78%	complex	410	146%
top	842	1.54%	difficult	359	1.28%
right	769	1.41%	limited	338	1.21%
support	766	1.40%	expensive	279	0.99%
important	765	1.40%	dangerous	268	0.96%
better	761	1.39%	critical	267	0.95%
benefits	694	1.27%	hype	267	0.95%
good	680	1.25%	vice	258	0.92%
best	644	1.18%	lack	255	0.91%
available	619	1.13%	impossible	246	0.88%
improve	579	1.06%	concerns	232	0.83%
leading	554	1.01%	disruption	216	0.77%
disrupt	542	0.99%	tamper	215	0.77%
significant	514	0.94%	sap	207	0.74%
free	499	0.91%	bad	180	0.64%
transparent	489	0.90%	slow	166	0.59%
great	481	0.88%	attack	155	0.55%
efficient	480	0.88%	hack	152	0.54%
trusted	453	0.83%	lost	152	0.54%
clear	431	0.79%	break	151	0.54%

Source: Author's own elaboration.

A total of 82,653 matches were found between the terms and the reference matrix of Liu (2010). Of these matches, 54,605 matches corresponded to positive feelings, and 28,048 corresponded to negative feelings. The most frequently used terms of positive feelings were work, well, secure, trust and innovation. Together, these terms represent 14.93% of the positive expressions. The most frequently used terms of negative feelings were problem, issues, risk, fraud and hard. Together, these terms represent 16.68% of negative expressions. The overall result is 26,557, indicating a positive positioning of texts in relation to blockchain. In the next section, these results are discussed in light of the theoretical framework of the study.

5 DISCUSSION

In the analysis of the most frequently used terms in the news, the results of knowledge discovery in texts indicate that "distributed" is among the most recognized characteristics of blockchain (Mougayar, 2016). The results also indicated a strong association of this characteristic with the terms bank, financial and companies (Table 4). The results reinforce the interest of financial industry institutions in blockchain and the advantages this technology can provide. The term bank stands out as the fourth most mentioned term in all the news analyzed, and shortly after that term are blockchain, technology and bitcoin, showing a strong relationship of the financial industry with blockchain. This finding is reinforced by the results of the perceptual map presented in Figure 1. Figure 1 shows that the term bank had a high association with the phenomenon in 2016. It is, therefore, one of the industries that more quickly noticed the blockchain's influence on technological strategies of companies.

Moreover, the results indicate a correlation of 0.89 between the terms industry and financial, which is reinforced by a strong correlation among the terms financial, blockchain and technology. A correlation of 0.84 was also found between the terms bank and blockchain, showing that financial industry, and especially the banks, are trying to anticipate the advantages of blockchain technology before they happen (Blackman & Henderson, 2004). The efforts of this industry to understand the distributed characteristics of blockchain to establish technological strategies based on blockchain and reap benefits from technological innovation (Husain, 2016) are therefore observed. Based on these results, the authors have drawn up the proposition P1.

Proposition P1: *The blockchain phenomenon is strongly affecting the technological strategies of the financial industry.*

Scholars argue that transactions require a reliable service manager that provides consensus regarding the occurrence of a particular transaction or event (Ondrus & Pigneur, 2009). Thus, transactions between individuals are only validated when they are reviewed by this central authority or a mediator to verify that the particular transaction was not fraudulent or invalid (Mainelli & Smith, 2015). Blockchain, in turn, enables transactions between unrelated parties without the need for central or mediating authority, since transaction logic makes transactional data accessible to all involved (Carrick, 2016). In other words, each blockchain is a transaction book of digital assets showing who owns what, who transacts what, what is transacted and when it is transacted. The registries, therefore, are not centralized in a single database,

but rather distributed in the computers of the network of users of the platform and available for consultation by any of those involved (Mougayar, 2016).

The results of knowledge discovery in texts revealed a high degree of relevance of the term transaction in the news studied. The frequency of this term reached 7,025 citations in the 3 years encompassed by the study. The analysis that was separated according to year of publication of the news shows that transaction is in the group of 5 most frequently used terms in all the years. In the association analysis presented in Table 4, it is verified that the term transaction has a high degree of correlation with the terms blockchain, business, company, financial, potential, industry and system. These results corroborate theoretical assumptions that blockchain will affect financial transactions (Iansiti & Lakhani, 2017, Lewis et al., 2017). From this analysis, the authors have drawn up the proposition P2.

Proposition P2: *Blockchain technology is affecting financial transactions by making the data accessible through a common platform.*

Cross-border payment is a banking sector topic that, so far, has reaped few benefits from recent digitization progress (Ali et al., 2014). Most international transactions are still processed using a matching banking system. However, this manual transaction entry system is not a scalable solution for the growing digital payments market (Mougayar, 2016). Blockchain eliminates the need for intermediary banks at the corresponding bank level, reducing fees, delays in payment processing and lack of transparency. In the field of business-to-business payments, blockchain can reduce costs and transaction time, since it will take the sender's payment to the recipient, thus avoiding intermediaries (Guo & Liang, 2016).

Additionally, cryptocurrencies such as bitcoin facilitate transactions and serve as a complement to emerging market currencies (Carrick, 2016). According to Guo and Liang (2016), the cost of each transaction in cross-border payments can be reduced by using cryptocurrencies based on blockchain. The remittance of national currencies involves complex, expensive and time-consuming processes that can be complemented by, and even replaced with, the use of cryptocurrencies. The most frequently used terms indicate that currency and cryptocurrency are among the most cited terms in the news. In the association analysis (Table 4), it has been verified that the term currency has a high degree of correlation with terms such as blockchain, bitcoin and bank.

The results of knowledge discovery in texts show the efforts of financial industry to use blockchain-based systems in cross-border payment services. The analysis of terms referring to payment systems between countries demonstrates an association

among payment, exchange and trade. Upon separating the analysis of terms according to their respective year of collection as presented in Table 3, it is observed that payment is among the 25 most frequently used terms in 2015 and 2016, showing a greater relevance for cases of payment systems. The analysis of feelings (Table 5), in turn, indicates a positive tendency for terms linked to payment systems without intermediaries, such as secure, trust, and available. Based on transactions and payment systems between countries and relating them to the discussion on cryptocurrencies, the authors have drawn up the proposition P3.

Proposition P3: *The technology strategy of financial industry has been enhancing cross-border payment services by means of blockchain-based systems.*

Blockchain follows the principles established in the creation of bitcoin (Nakamoto 2008). Blockchain is public, decentralized and accessible (Mougayar, 2016). Some authors state that the greatest benefit of blockchain is the open access, which removes intermediaries from the processes (Iansiti & Lakhani, 2017; Halaburda, 2018). However, the interest of the financial industry has boosted the development of blockchain platforms designed for private environments in which participants need to be authenticated. Applications for securities trading and settlement, asset and financial management, banking and insurance are being built using these private platforms (Lewis et al., 2017). Most of these applications adopt blockchain platforms, which require some involvement of a trusted third party (Halaburda, 2018).

In this context, the results have demonstrated the emergence of blockchain platforms that allow private or permissioned blockchains, such as hyperledger and corda blockchains, and platforms, such as the ripple based on permissions controlled by a consortium of companies (Neyer & Geva, 2017). The results of knowledge discovery in texts demonstrated a relevance of public platforms of blockchain, such as bitcoin and ethereum, which are among the most frequently used terms in the news. The other platforms were also mentioned. Hyperledger was the third most frequently used term, with 622 occurrences, followed by the term ripple, with 508 occurrences, and by the term corda, with 156 occurrences. While public platforms of blockchain are the public platforms that have appeared the most in all of news analyzed from the three years, there was a growing increase in the quotations of the other platforms. From this analysis, the authors have elaborated the proposition P4.

Proposition P4: *The technology strategy of financial industry has boosted the development of private blockchain technologies.*

The propositions generated in this article contribute to practical application through the findings related to the theoretical background. By means of the knowledge discovery in texts, it was possible to identify patterns that were discussed considering blockchain theories, as well as technological strategy. In a practical way, these propositions should be considered by financial companies interested in focusing their technological strategy on blockchain. The four propositions are listed in Table 6, summarizing the main contributions of this study.

Table 6 - Propositions: How blockchain affects technological strategy of the financial industry

Nº	**Proposition**
P1	The blockchain phenomenon is strongly affecting the technological strategies of the financial industry.
P2	Blockchain technology is affecting financial transactions by making the data accessible through a common platform.
P3	The technology strategy of financial industry has been enhancing cross-border payment services by means of blockchain-based systems.
P4	The technology strategy of financial industry has boosted the development of private blockchain technologies.

Source: Author's own elaboration.

6 CONCLUSIONS

Disruptive technologies have transformed industries, forcing companies to realize the importance of technology strategy for their growth. Strategic foresight helps decision-making about the adoption of new technologies, taking into account market trends and needs. Blockchain has been embraced in business discourse, and it has been incorporated into corporate strategies in some industries. This article was proposed in order to answer how blockchain is affecting technology strategy of the financial industry. To that end, exploratory research with a quantitative approach was carried out using techniques of knowledge discovery in texts, with the use of text mining tools. The text dataset was explored using correspondence analysis, sentiment analysis, association analysis, and hierarchical grouping analysis. The results confronted the theoretical background of technology strategy with blockchain information that had been published by news websites. Thus, it was possible to map blockchain and its impact on the technology strategies of the financial industry.

This approach made it possible to go beyond the understanding of blockchain technology. Based on a large dataset of business news, our study evidence the recent

effect of blockchain technology on corporate strategic decisions of the financial industry. Two findings stand out: the establishment of private blockchain and its application in the cross-border payment services. Those findings have practical and managerial implications too. Like any technology that comes to market, the blockchain imposes challenges to its adoption. Managers must deal with the negative feelings about blockchain demonstrated in this study, such as risk, fraud and complexity. Moreover, the disintermediation proposed by this technology will challenge the predominant business model of the financial industry. Particularly for banking institutions, blockchain can transform transactions in the same way that the Global Positioning System has transformed the transport of freight and people by making data accessible through a common platform. The development of private platforms, highlighted by this study, is not a sufficient technology strategy to deal with this issue. Thus, managers of the financial industry will be challenged to build distributed business models to generate and capture value.

At the same time, blockchain opens new opportunity windows. A practical implication related to proposition P2 is the possibility of merging current data storage platforms into blockchain platforms. A secure blockchain-based platform would reduce the cost of the user's data storage and increase the financial services efficiency. Another practical implication is related to proposition P3. While enhancing transactions in cross-border payment services, blockchain technology cuts the margins obtained by the banks that offer them. As a result, based on the blockchain's advantages, bank managers will have to generate a technologically safer and less costly cross-border payment service. The winning solution should be able to balance the benefits offered to issuers, users and governments.

The results are not conclusive, and some limitations should be noted. The research design used techniques of text mining that were made available by software and, therefore, they were limited to the technical parameters of each software. For example, it was not possible to analyze the frequency of terms that are composed of more than one word. In the same way, the results were not able to obtain fine grain domain specific information. The extracted news items sample was also affected by the query limitations of the search software. The analysis presented is limited to the data collection timeframe. Furthermore, there were limitations related to the different data structure characteristics of the websites from which the news was extracted, as well as the quantity of programming codes that were extracted along with the texts.

The findings of this article do not conclude the discussion related to blockchain's effect on the technology strategy of the financial industry. New avenues of research

are encouraged because blockchain is a technological phenomenon in the phase of dissemination and consolidation.

Future studies, therefore, could test the propositions that have been created here in order to verify their validity in other contexts and industries. Another opportunity for study is connected to the impact of blockchain on government institutions, focusing, for example, on central banks. It is also hoped that studies will be carried out regarding the impact of blockchain on different business aspects, such as the management of supply chains (Treiblmaier, 2018). Finally, as evidence of the relevance of cryptocurrencies was found in this article, a broad avenue of research encompasses the regulatory issues of such currencies. The spread of blockchain technology and the proliferation of its adoption will provide a broader database for robust statistical methods. It is hoped that this systematization helps researchers to explore the richness of the phenomenon in depth.

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The authors declare that they have no conflict of interest.