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RESEARCH PAPER

Knowledge Management and Blockchain Technology for Organizational Sustainability: Conceptual Model

Talita Frozza[1], Edson Pinheiro de Lima[1], Sérgio Eduardo Gouvêa da Costa[1/2]

[1]Federal University of Technology (UFPR), Prato Branco, Paraná, Brazil.

[1/2] Pontificia Universidade Catolica do Paraná (PUCR), Prado Velho, Curitiba, Paraná, Brazil.

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ABSTRACT

Goal: This paper develops a conceptual model representing existing relations between blockchain, knowledge management, and sustainability.

Design/Methodology/Approach: A systematic literature review was carried out, and a total portfolio of 43 articles was obtained. These articles were then analyzed using the content analysis technique.

Results: Identifying the existing relationships between blockchain and knowledge management and between knowledge management and sustainability was possible. This information allowed the elaboration of the conceptual model, which resulted in the identification of the roles of each theme when related to each other.

Limitations of the investigation: The limitations refer to the diversity and complexity of the themes, which made it necessary to limit the search for articles to two databases; the temporality of the research due to the evolution of the blockchain; and the failure to consider the risks arising from the adoption of technology and the negative aspects of the relationships between the themes.

Practical Implications: With this article, companies studying blockchain adoption, looking for ways to improve knowledge management, or seeking to adjust their impacts on sustainability, can find information that helps in decision making.

Originality/ Value: This article proposes a conceptual model that explains the relationship between three current and increasingly essential topics for organizations. To this end, it seeks to identify in the literature how the application of the first (blockchain) improves the execution of the second (knowledge management) and how this impacts the third (sustainability).

Keywords: Blockchain; Knowledge Management; Sustainability; Conceptual Model.

1. INTRODUCTION

The objective of this research, that is, the development of a conceptual model that represents the existing relationships between blockchain technology, knowledge management (KM), and organizational sustainability, arises from the identification of a context of the opportunity to use blockchain to improve organizational processes of knowledge management and, consequently, organizational sustainability.

Blockchain technology, constantly associated with Bitcoin cryptocurrency, has the potential to offer new solutions to long-term problems in numerous sectors, both in public and private services

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(Probst et al., 2016; Olnes et al., 2017; Yuan and Wang, 2018), there are already numerous applications benefiting from the blockchain structure (Meiriño et al., 2019).

One of the potential applications of blockchain technology is knowledge management because sophisticated technologies play a substantial role in KM (Tzortzaki and Mihiotis, 2014), especially if one considers the scenario of globalization and the information age, where companies live immersed in a flood of data that makes it challenging to acquire the correct content necessary for the best performance of activities. For all this knowledge to circulate, its flows must be properly parameterized and efficiently managed (Pinto, 2020). Thus, technologies such as blockchain can increase people's efficiency and improve the flow of information within organizations (Bhatt, 2001).

In addition, it can be mentioned that KM faces challenges such as issues of power and trust, security in the production and transfer of knowledge, and issues of knowledge-sharing motivations (Butler, 2000; Akhavan et al., 2018; Hu et al., 2018), and given that the blockchain enables aspects such as trust, transparency, and immutability to the database (Yang, 2019), it has the potential to face the challenges encountered and improve knowledge management (Akhavan et al., 2018).

From the mitigation or elimination of the challenges found in KM, such as those mentioned, organizations also start to improve other organizational aspects, such as organizational sustainability, because, despite the growing consensus around the importance of organizational sustainability, organizations still face problems with the absence of a comprehensive management structure that meets, balances and integrates the three dimensions of sustainability: economic, environmental and social, also called Triple Bottom Line.

Several scholars have argued that a high learning capacity is a crucial characteristic of successful organizations in the modern world. This is a vital capacity that impacts, among others, sustainability performance (Jamali, 2006). An organization's ability to learn, in turn, increases when it consciously employs processes that help nurture, leverage, and motivate people to improve and share their ability to act, processes that encapsulate the notion of KM (Tzortzaki and Mihiotis, 2014), understood in this research as the structuring and modeling of change processes that occur in an organization's knowledge base and that impact organizational learning (Probst et al., 2002).

In this context, considering the potential that blockchain has to offer solutions to technological problems for organizations; considering the barriers that hinder the implementation of KM within organizations, and the need for a comprehensive management structure that enables the more significant achievement of organizational objectives in terms of sustainability, the aim is to develop a conceptual model representative of the existing relationships between blockchain, KM and organizational sustainability. To achieve this objective, it is sought to identify in the literature which aspects of blockchain, applied to KM, can enhance the use of organizational knowledge and later how KM can impact sustainability.

2. RESEARCH BACKGROUND

The following paragraphs briefly describe the fundamentals of blockchain, KM, and organizational sustainability to elicit the concepts that guide the conceptual model development.

2.1 Blockchain

A blockchain is a form of Distributed Ledger Technology (DLT) - distributed accounting technology (Olnes et al., 2017; White, 2017), which consists of a shared database that is replicated and synchronized in a decentralized manner among the members of a network (Yang et al., 2018). It allows the digital transfer of assets between two unknown entities without the need for trusted third parties (Kewell et al., 2017), thus dispensing the need for a central authority to validate transactions (Dunphy and Petitcolas, 2018), reallocating the responsibility for managing transfers to computers and algorithms (Kewell et al., 2017). The main features of blockchain are:

a) Decentralization: in traditional mechanisms, a central authority responsible for validating transactions is required, which inevitably impacts the cost and performance of central servers. In the blockchain, information is automatically shared and distributed among the network members or nodes without any third-party intervention, and consensus algorithms are used to maintain data consistency in the distributed network (Zheng et al., 2018; Yang, 2019; Lin and Liao, 2017).

b) Mutual trust: mutual trust is an essential factor for trading participants, and blockchain is often referred to as a technology that overcomes the need for trust in relationships. Because it is based on the principles of peer-to-peer network protocols and purely mathematical methods, it creates trusting relationships between network nodes and distributed system structures (Beck, 2018; Yang, 2019).

c) Transparency: the registration of data by the blockchain is transparent for each member of the network, i.e., all participants share records and consult data. However, the amount of transparent information for an observer can be different, and not every participant should

necessarily have the same access to all information (Wüst and Gervais, 2018; Yang, 2019).

d) Cryptography: Blockchain performs data encryption and digital signatures through asymmetric cryptography. Data encryption ensures the security of transaction data and reduces the risk of loss or falsification of transaction data. The digital signature, in turn, allows the identification of the transaction signatory, which does not necessarily reveal the real identity of the user since each user can interact with the blockchain through a generated address (Zheng et al., 2018, Yang, 2019, Lin and Liao, 2017).

e) Traceability: each block of information in the blockchain has the date and time information, which serves to identify, record, and validate each transaction, which not only improves the time dimension of the data but also guarantees its originality, improves transparency, and reduces the cost of transaction traceability, as users can quickly check and trace previous records by accessing any block in the network (Zheng et al., 2018; Yang, 2019).

f) Immutability: for a transaction to be validated and added to a block, it must be reviewed by most system nodes. Once validated and added, it cannot be violated. The exception to the case is if any of the nodes in the network control 51% or more of all nodes (Wüst and Gervais, 2018; Yang, 2019).

As with any new and potentially transformative technology, blockchain adoption has substantial risks. Among the risks, it can be mentioned the dependence of technology on consensus mechanisms, which are sometimes flawed; the need for computing power and consequent CO2 emission (Beck et al., 2018); significant investment needs (Hughes et al., 2019); usability limitations, size, and bandwidth limitations, among others; all of which need to be quantified and evaluated by organizations (Mendling et al., 2018).

2.2 Knowledge Management

Knowledge plays a vital role in efficiency and effectiveness in organizational operations, and the maturity stage of the knowledge society puts the KM processes in the showcase of organizations (Muthuveloo et al., 2017; Yee et al., 2019; Krause et al., 2019).

There are numerous ways to define KM, but this study adopts the definition that Probst et al. (2002) presented. They describe it as the structuring and modeling of change processes in an organization's knowledge base, which impact organizational learning, being the processes: identification, acquisition, development, sharing and distribution, use and retention of knowledge.

The volume of knowledge has grown at an impressive rate and has become increasingly specialized, generating the need to know where to find the necessary knowledge. And that's what the knowledge identification process is all about. Knowledge, both internal and external knowledge is not automatically visible; in this sense, KM needs to ensure sufficient transparency and help the organization find what it needs. Knowledge visibility exposes existing gaps within organizations and allows them to choose between acquiring or developing knowledge. Thus, in as much as knowledge acquisition is concerned, this is a process of importing knowledge from external sources, such as clients and suppliers; as well as of "purchasing" knowledge through hiring people with the right skills, such as experts and consultants; by accessing knowledge bases; or by acquiring knowledge products, such as software.

The acquisition of knowledge by companies is a viable alternative. However, this solution is also available to competitors, which emphasizes the importance of companies being able to develop understanding from their resources. The knowledge development process refers to the generation of new skills, new products, better ideas, and more efficient processes. It is a process that includes all administrative efforts consciously directed towards producing competencies that are not yet present in the organization.

The process of sharing and distributing knowledge has a prominent position in KM. This is because it enables or hinders its effective application. In other words, it is a vital prerequisite to transform information and experience into something that every organization can use, which can only be used if available to those who need to make decisions.

All processes already mentioned (identification, development, acquisition, sharing, and distribution) must always be related to the needs of potential users, in other words, using knowledge. The integral objective of KM is to ensure that the knowledge present in the organization is used for its benefit since knowledge has no value if it is not used.

Finally, one encounters the knowledge retention process. Parts of the organization's memory may be lost, temporarily or permanently, due to reengineering, outsourcing, or lean management policies. Thus, selectively retaining information, documents, and experiences of the organization requires management and plays an important role considering that the past experiences form a reference structure for future learning processes (Probst et al., 2002).

2.3 Organizational sustainability

Sustainable development is seen as an emerging business megatrend and has forced persistent changes in how companies compete (Lubin and Esty, 2010). At the business level, it can be defined as meeting the needs of the organization's direct and indirect stakeholders without compromising its ability to meet the future needs of these stakeholders (Dyllick and Hockerts, 2002). And as in the macro level of sustainable development, organizational sustainability has three dimensions, addressed by the term Triple Bottom Line: economic, social, and environmental (Baumgartner and Ebner, 2010).

The economic dimension of organizational sustainability has been discussed as a dimension that does not strictly refer to an organization's conventional financial accounting but instead to the generation of added value (Jamali, 2006). The measurement of an organization's economic performance focuses on how the economic status of stakeholders' changes as a result of the organization's activities. This means that the performance is not measured based on the organization's financial condition and exposes that an organization "is only sustainable when it pays taxes to the public authorities, adequate prices to its suppliers and wages to its employees, interests to its creditors and (at least at a given moment) dividends to its shareholders" (Steurer et al., 2005, p. 9).

As of this, it is possible to expose that the economic dimension of organizational sustainability has often been discussed as a generic dimension, which covers general aspects of an organization that must be respected so that it remains in the market for a long time. These aspects include innovation and technology, collaboration, KM, processes, purchasing, and sustainability reports (Baumgartner and Ebner, 2010).

In turn, the social dimension of organizational sustainability focuses on the organization's impact on the social systems in which it operates (Jamali, 2006) and the positive influence of all present and future relationships with the organization's stakeholders (Baumgartner and Ebner, 2010). And to be socially responsible, the organization must adopt and balance the economic, legal, ethical, and discretionary expectations of all stakeholders, both internal and external, and interest groups of civil society (Bansal, 2005; Jamali, 2006).

Social dimension outcomes can incorporate "public health issues, community issues, public controversies, skills and education, social justice, workplace safety, working conditions, human rights, equal opportunities, and labor rights" (Jamali, 2006, p. 4).

The environmental dimension of organizational sustainability deals with the environmental impacts of organizational activities in living and non-living natural systems, including ecosystems, land, air, and water (Baumgartner and Ebner, 2010; Jamali, 2006).

The search for the environmental dimension of corporate sustainability must go beyond initiatives such as recycling and energy efficiency or compliance with applicable government regulations. One can understand, then, that the search for meeting the environmental dimension of sustainability also consists of acting in a comprehensive approach that involves a company's operations, products, and facilities. This includes evaluating products, processes, and business services, maximizing the efficiency and productivity of all resource assets, and minimizing practices that may affect the use of environmental resources for future generations (Jamali, 2006).

3. RESEARCH METHOD

To achieve the objective of this research the systematic literature review is used as a procedure, consisting of a specific literature review that uses a set of rules to assist in the selection and analysis of the content under study (Kluska et al., 2018). The systematic literature review of this research is conducted and followed by the Cochrane Organization for conducting a systematic review (Higgins and Green, 2008).

Step 1 - which involves the development of criteria for the inclusion of studies - is specified in Table 1. Considering that the research topics are entirely different and complex, the systematic review of the literature is carried out individually for each topic.

Table 1- Questions of the review and criteria for inclusion of studies

Theme	Research question	Criteria for inclusion of studies
Blockchain	What are the main features of blockchain?	- disregard articles: that exclusively address the application of the technology in the financial market; that address unique blockchain themes, such as smart contracts. - include articles that addressed, in addition to the basic characteristics of blockchain, issues such as

		benefits, implementation difficulties, and application examples.
Knowledge Management	What are the main aspects of Knowledge management?	- disregard articles: that had as purpose only the definition of frameworks or models; that approached knowledge management in a very specific context, such as social media, micro, and small companies and supply chain. - consider articles: that addressed Knowledge management in conjunction with information systems or organizational processes; that addressed knowledge management in a general context.
Sustainability	What is the approach to sustainable development in organizations?	- disregard articles: that addressed a single dimension of sustainability; that had as an objective only case study. - consider articles: that addressed sustainable development, triple bottom line, and corporate sustainability.

Source: The authors themselves (2021).

Once the focus of the research is determined, for the completion of Step 2, a search of studies is necessary: to identify the databases, define the terms and search criteria and conduct the search according to the specified criteria. Table 2 presents these definitions:

Table 2- Definition of databases, search terms, and criteria

Keywords:	**blockchain and block chain**	**knowledge management, creation, and share**	**sustainability, triple bottom line, social, environment, economic, corporate, and service operation**
Operator:	OR	AND and OR	AND and OR
Database:	Scopus and Web of Science	Scopus and Web of Science	Scopus and Web of Science
Year:	Not limited	Not limited	Not limited
Language:	English only	English only	English only
Type:	Article and *conference paper*	Article	Article
Limiter:	15 citations or more	25 citations or more	15 citations or more

Source: The authors themselves (2021).

Because the literature on the application and influence of the underlying techniques of blockchain only began to appear in 2013 (White, 2017), the "conference paper" type is also selected, given that it is a current theme and increasing the types of research allows reaching a more suitable number for the portfolio. Also, the limiter "number of citations" is used to select articles considered of greater relevance. Using different limiters is necessary because carrying out tests in the databases to search for the KM theme, with a filter of only 15 citations, results in an extensive portfolio that could make the research unfeasible. Thus, it is decided to increase the citation filter for the KM theme to 25 citations.

The result of applying the search terms and criteria defined in Table 2 are presented in greater detail in Appendix B.

In Step 3, the studies are selected according to the criteria established in Table 1. This selection is conducted in two stages: an initial screening through reading titles and abstracts of the studies found and a screening of the resulting portfolio, considering the full reading of the works. With this process, the final portfolio has 43 articles, 12 on the blockchain, 17 on knowledge management, and 14 on sustainability.

The articles obtained in the systematic literature review are then analyzed using the Content Analysis technique. This technique consists of "a set of techniques for communications analysis that uses systematic and objective procedures to describe the content of the messages" and is performed through three steps: organization of the analysis, coding, and categorization (Bardin, 1977, p. 38).

With the content analysis, several critical factors in the literature are identified, which enable

the development of a detailed narrative to support the conceptual model. For the identification of such key factors, considering that the step of searching material in the databases of the systematic literature review is performed individually for each of the themes studied, to enable the identification of such factors and relate the themes to each other, each portfolio is analyzed by searching for specific terms.

To support this stage's development, acquiring and using specific content analysis software is impossible. Thus, content analysis steps such as coding and categorization are performed with the support of a spreadsheet editor program.

From the blockchain portfolio, separated excerpts of the articles discussed the terms "organizational processes," "knowledge management," and "sustainability." The articles that made up the portfolio of knowledge management were separated into excerpts related to the terms "organizational processes," "sustainability," and "technology." In the sustainability portfolio excerpts that addressed "organizational processes," terms related to "knowledge management" and "technology" were separated.

With this, it is possible to establish the relationships between the themes of blockchain and knowledge management and sustainability, which support the conceptual model presented in the following section.

4. RESULTS

The preparation of the conceptual model in this research has as an initial assumption the need for a digital infrastructure to effectively manage knowledge, having as a premise that the application of blockchain in KM can, through its characteristics, eliminate or mitigate problems encountered by the KM, enabling a greater and better application of knowledge in organizational processes. The second assumption is that this application of knowledge in these processes generates impacts, both direct and indirect, on sustainability, understood in this research as the result of organizational activities, analyzed by the concept of the Triple Bottom Line, which addresses the dimensions: economic, social, and environmental.

The model is composed of three variables: the blockchain, understood as a resource, the KM, understood as the processes through which the resource is mobilized; and sustainability, understood, specifically in this relation, as the result of the mobilization of the blockchain resource in the KM processes.

However, before presenting the theoretical model, it is essential to give the information found in the articles that make up the bibliographical portfolio and that demonstrate how KM can impact sustainability because of organizational activities and what aspects of blockchain, applied to KM, can enhance the use of the organizational knowledge resource.

4.1 Establishing relationships

For KM processes to be carried out successfully, some organizational barriers must be mitigated or eliminated. And it is in this perspective that the blockchain is inserted, aiming to mitigate barriers or enhance KM processes.

Thus, from the content analysis of the articles obtained through the systematic review of the literature, Table 3 was prepared, representing the relationship between KM and blockchain, organized from the content analysis of the articles of these two themes obtained with the systematic review of the literature. Table 4, below, brings the arguments that support the preparation of Table 3, which indicates the relationships for which arguments are found in the articles that explain or describe the relationships between such aspects.

It is essential to point out that, although the existence and knowledge of the risks involved in the adoption of blockchain technology for organizations are admitted, the content analysis of the portfolio aims only at identifying potentially positive relationships generated by the application of blockchain in KM, such as a way to limit the objective of the research and not make it unfeasible.

Table 3- Matrix of relations between knowledge management and blockchain

	Decentralization	Mutual trust	Transparency	Encryption	Traceability	Immutability
Identification			X	X	X	
Acquisition						
Development				X	X	
Sharing	X	X	X	X		
Use	X		X			X
Retention	X	X			X	X

Source: The authors themselves (2021).

As shown in Table 3, it is possible to identify that one of the processes of KM - Acquisition is not found in the literature arguments demonstrating how the blockchain can add value to the process or eliminate problems in its execution. The other relationships presented in the table it is shown in Table 4, descriptions achieved as the content analysis and that aim to highlight the relations between the themes:

Table 4- Relations between knowledge management and blockchain

Knowledge management process x Blockchain features	
Knowledge identification and:	
Transparency:	Through this feature, the organization's knowledge becomes more visible, which consequently increases the organization's ability to find the knowledge it needs when needed. E.g.: Lin and Liao (2017); Lang (2001).
Cryptography:	Through digital signatures made possible by cryptography, it becomes possible to identify the holders of knowledge, enabling the preservation of intellectual property rights or copyrights of the knowledge shared among employees. E.g.: Wust and Gervais (2018); Hughes et al. (2019); White (2017).
Traceability:	This characteristic allows the identification of the context in which knowledge was produced, an important factor for other knowledge management processes. E.g.: Kwan and Balasubramanian (2003); White (2017).
Knowledge development and:	
Cryptography:	Provides, through digital signature, conditions to ensure that employees develop knowledge within the organization, and have their copyrights ensured. E.g.: Wust and Gervais (2018); Hughes et al. (2019).
Traceability:	By identifying the context surrounding the knowledge, previous lessons can be used for the development of new knowledge. E.g.: White (2017).
Knowledge sharing and:	
Decentralization:	With this feature, information is automatically distributed among members, which meets the need for knowledge management to be integrated into the workflow of organizational processes so that it is captured automatically. E.g.: Kwan and Balasubramanian (2003); Hughes et al. (2019); Clarke (2001).
Mutual trust and immutability:	Through the control generated by the immutable maintenance of records, an increase in the confidence of network members in sharing knowledge is generated. E.g.: Hughes et al. (2019); Mendling et al. (2018).
Cryptography:	Through digital signature, it provides conditions for experts, under the rights of the organization, to share their knowledge. Also, cryptography ensures security and reduces the risk of loss or forgery in a transaction. E.g.: Yeoh (2017); De Long and Fahey (2000).

Transparency:	The information can be accessed by external people and entities, which favors the relationship with the organizations' *stakeholders.* E.g.: Kewell et al. (2017); Hughes et al. (2019).
Use of knowledge and:	
Decentralization:	As knowledge is stored in multiple locations, access to that knowledge becomes easier and faster. E.g.: Kwan and Balasubramanian (2003); Hughes et al. (2019).
Transparency:	With this characteristic, knowledge can be accessed and effectively used by anyone inside or outside the organization. E.g.: Hughes et al. (2019).
Immutability:	It provides authenticity and veracity to the available knowledge, mitigating the users' concern about the authenticity of the knowledge source that is available. E.g.: Zheng et al. (2017)
Knowledge retention and:	
Decentralization:	Knowledge retention is favored because data is stored in multiple locations and consensus mechanisms ensure that information is only changed when all relevant parties agree. It also increases security in the production and transfer of knowledge, since the storage of information in central servers generates insecurity for users. E.g.: Zheng et al. (2017)
Mutual trust:	As a result of consensus protocols, confidence is provided that the information stored matches reality. E.g.: Zheng et al. (2017)
Traceability:	The union of this characteristic with the knowledge retention process favors the organization's ability to track the history of processes, which is made available favors the predictive capacity and allows lessons from previous actions to be captured and shared. E.g.: Zheng et al. (2018); Mendling et al. (2018); Demarest (1997); Bhatt (2001).
Immutability:	Through this characteristic, after the knowledge is retained, it is difficult to alter or delete it without notice. E.g.: Zheng et al. (2017); Mendling et al. (2018)

Source: The authors themselves (2021).

Thus, it is possible to identify in the literature which aspects of the blockchain, applied to KM, can enhance the use of the organizational knowledge resource. Blockchain can positively impact almost every KM process except the knowledge acquisition process. In the other processes, technology features such as encryption and traceability allow, respectively, to provide conditions to ensure that employees and specialists develop knowledge within the organization and have their copyright guaranteed, and to provide the context in which certain knowledge was produced important aspects for to KM.

Afterward, from the content analysis of the portfolio articles, especially on knowledge management and sustainability, it was possible to identify that all KM processes, to a greater or lesser degree, have a relationship and generate impacts in the dimensions of sustainability. These relationships are demonstrated and exemplified in Table 5:

Table 5 - Relations between knowledge management and sustainability (a)

Knowledge Management Process		
1) Identification of knowledge: it concerns the ability of the organization to know where to find what it needs when it is needed.		
Dimension	**The process allows the organization to:**	**Example**
Economic dimension	• Enhance innovation; • Maintain competitive advantage; • Produce new and different products; • Observe new measures of wealth.	If an organization does not easily locate the right kind of knowledge in the right form, the company may find it difficult to maintain its competitive advantage. [...] an organization must be quick to find the right kind of knowledge in the right way (Bhatt, 2001).

Social dimension	• Obtain knowledge about the environment in which it is inserted; • Devise strategies to adapt to this environment; • Promote increased customer satisfaction; • Increase the ability of employees to deliver the results for which they are responsible; • Efficiently support employees through appropriate motivations and incentives.	The customer intimacy value proposition focuses on capturing and sharing information and knowledge about organizations' customers. It focuses on understanding customer needs and preferences and leveraging that knowledge to develop new products and services, increase customer satisfaction, and increase customer buying patterns (Butler, 2000).
Environmental dimension	• The impacts are generally aimed at improvements in workflow efficiency and consistency.	KM efforts aimed at improving access and retrieval of such information can therefore improve workflow efficiency and consistency (Raghu and Vinze, 2007).

(b)

2) Acquisition of knowledge: refers to the importation of knowledge from external sources, such as customers, suppliers, competitors and partners, as well as the "purchase" of knowledge.		
Economic dimension	• Develop new products and services desired by customers and in defense of market share and distinction.	Typically, organizations are reaping the following benefits from knowledge management initiatives: [...] defending market share against existing competitors; [...] to defend market share against new entrants (Butler, 2000).
Social dimension	• Improve the relationship with customers, as well as their support; • Be aware in advance of stakeholder reactions to your social/environmental performance.	Sectors that depend on relationships, such as retail, use knowledge management to improve customer service and offer greater depth and quality of product and service (Clarke, 2001).
Environmental dimension	• Minimize the environmental impacts of products and services throughout their life cycle; • Act in compliance with laws and regulations.	Typically, organizations are returning the following benefits from knowledge management initiatives: [...] better positioning for regulatory/legislative changes (Butler, 2000).

(c)

3) Knowledge development: it concerns the generation of new skills, new products, better ideas and more efficient processes.		
Economic dimension	• Increase the ability to develop new ideas and solutions that add value or reduce costs; • Generate new skills and more efficient processes; • Improve employee productivity.	A knowledge management philosophy emphasizes collaborative learning so that they can add more value to their products and services for customers (Bhatt, 2001).
Social dimension	• Produce skills not yet present in the organization; • Empower employees; • Favor organizational learning; • Improve staff retention.	Making knowledge available to the right worker, at the right time and place, is vital to building and maintaining an organization's competencies (Kwan and Balasubramanian, 2003).

Environmental dimension	• Enhance innovation; • Drive improvements in the efficiency and consistency of workflows.	Knowledge management has gained importance since the 1990s. Companies hope to improve their ability to innovate and increase process efficiency (Gronau and Weber, 2004).

(d)

4) Knowledge sharing: it is a vital precondition for transforming information and experience into something that every organization can use.		
Economic dimension	• Favor the development of desired products and services; • Improve decision-making ability.	The transfer of this knowledge ultimately improves the operational performance of the organization as a whole, resulting in reduced expenses and increased revenue (Butler, 2000).
Social dimension	• Emphasize collaborative learning; • Favor feedback; • Support learning cycles; • Build strong relationships with stakeholders through transparent operations.	An important aspect is to allow feedback and learning cycles between the different levels and phases, i.e. experience from operational levels is transferred back to the strategic and normative level, as well as experience from the strategic level being transferred to the normative level (Baumgartner, 2014).
Environmental dimension	• Sharing best practices; • Apply environmental criteria at all decision-making levels.	To obtain such efficiencies, companies must apply environmental criteria at all decision-making levels and redesign dated operations and processes (Bansal, 2002).

(e)

5) Use of knowledge: ensure that the knowledge present in the organization is used for its benefit, since knowledge is worthless if it is not used. It is related to the three dimensions. It provides the appropriate environment and mechanisms to ensure that ideas are incorporated into products and services, ensures that the knowledge present in the organization is used for its benefit, changes the way the company's cultural infrastructure operates when it embeds knowledge in cultural and organizational values, and changes the way the company's 'mechanical' infrastructure operates.
"The view that knowledge embodied in new products and services has become the main source of wealth creation and the source of sustainable competitive advantage is stimulated by various impulses [...] of the new economy" (Clarke, 2001).

(f)

6) Retention of knowledge: selectively retaining information, documents and organizational experiences requires management and plays an important role, given that past experiences form a reference structure for future learning processes.		
Economic dimension	• Let lessons learned be captured and shared; • Form a frame of reference for future learning processes; • Improve decision-making capacity; • Keep processes and functions clear and defined so that activities are conducted efficiently.	[...] ensure that lessons learned from past successes and failures of the product are captured and shared through the development of an appropriate process (Butler, 2000).
Social dimension	• Allow activities to be conducted efficiently; • Increase the ability of employees to deliver the results for which they are responsible; • Increase confidence and job satisfaction.	Better knowledge support will allow more work to be done the first time, increasing confidence and job satisfaction (Wiig, 1999).

Environmental dimension	• What activities are conducted efficiently?	GC efforts aimed at improving access to and retrieval of such information can therefore improve workflow efficiency and consistency. [...] The definition of business rules requires effective capture of the organization's knowledge and best practices in the sector (Raghu and Vinze, 2007).

Source: The authors themselves (2021).

From this information, it is possible to identify how each KM process impacts the sustainability of an organization, more specifically in each of its dimensions. It was possible to locate that KM significantly affects the three dimensions of sustainability: economic, social, and environmental. The impact of KM can be identified in numerous organizational aspects related to sustainability, such as the development of new products and services desired by customers, the improvement of innovation, efficient support to employees through adequate motivations and incentives, and enables, by maintaining a clear definition of processes and functions, that activities are conducted efficiently.

Thus, considering the relationships between the variables presented and the arguments that support and justify these relationships, it is possible to formalize the proposed conceptual model, considering the objective of studying and understanding how the blockchain helps in the execution of KM and how it impacts the results - sustainability of organizations. The model is presented in Figure 1.

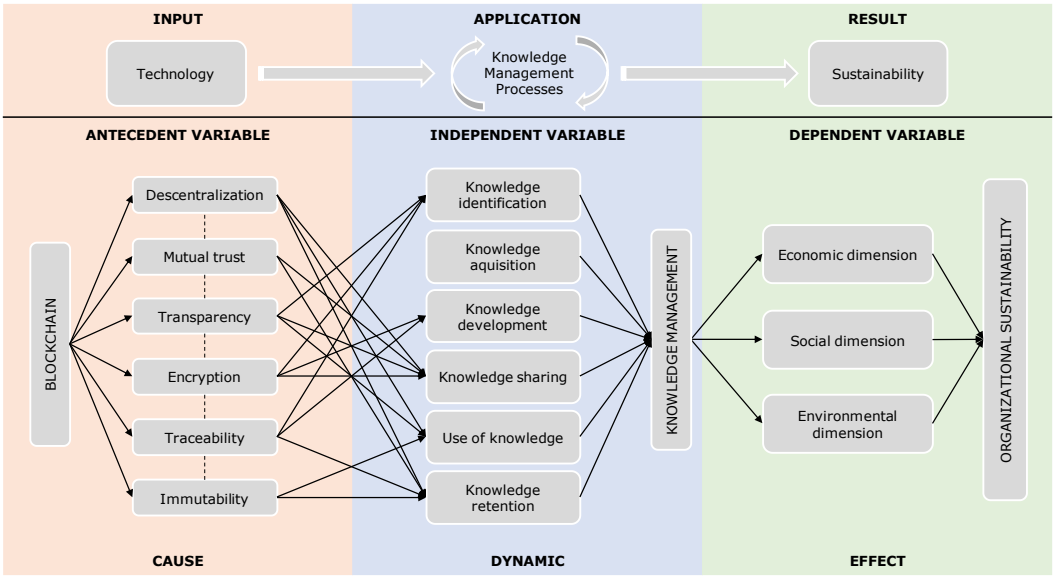

Figure 1- Conceptual model
Source: The authors themselves (2021).

The question in this model consists of the summary exposition of the elements that compose it. The technology, blockchain, constitutes the input of the model, being treated as an organizational resource. Then it is applied to the KM, which assumes the role of a knowledge transformation element in the model. This application of the blockchain resource to KM results in organizational sustainability, seen in the process as an output of this application of the blockchain resource in KM processes.

The model continues with the exposition of the variables and seeks to represent the existing relationships between the themes studied. The relationship between KM and sustainability in this model can be considered as a temporal relationship of dependence, existing in this relationship in addition to the independent and dependent variables, also an antecedent variable.

As its name suggests, the antecedent variable is found before the other variables. It indicates a compelling and accurate influence that clarifies the consequences that precede the relationship between the independent and dependent variables (Marconi and Lakatos, 2003). In the model, the theme that assumes the role of this variable is blockchain technology since it precedes the relationship of change and impact between KM and sustainability, from its application to the

management of organizational knowledge.

KM is the independent variable, which consists of the variable responsible for affecting another variable, the condition or cause of a particular result or consequence. It is the factor of the relationship that can be manipulated (Marconi and Lakatos, 2003). KM is understood as the independent variable because the improvement of KM processes, which are responsible for changing the knowledge base of an organization and whose objective is the adequate availability and application of knowledge, causes impacts on the organization, and the impacts studied in this research focus on organizational sustainability, understood as a result.

Sustainability, in turn, assumes the role of a dependent variable in this relationship. This variable is the part of the relationship that varies as the independent variable is modified; that is, it is the effect or result of something manipulated (Marconi and Lakatos, 2003). It is understood as a dependent because the impacts on the dimensions of sustainability vary according to changes in the independent variable, that is, KM (Richarson, 1999). Blockchain, as an antecedent variable, does not rule out the relationship between KM and sustainability but clarifies the influences that precede this relationship (Marconi and Lakatos, 2003).

5. CONCLUSION

The diversity of potential applications of blockchain technology and the embryonic state of research in this field stimulated interest and publications on the subject (Meiriño, 2019), as is the case of the present research, which aims to develop a representative conceptual model of the relationships between blockchain technology, KM and sustainability.

More than that, the objective of the research derives from potential relationships between the themes addressed. Blockchain technology is seen as a solution to organizations' technological problems; KM, in turn, encounters several barriers to its execution; and sustainability, finally, lacks a comprehensive management structure that makes it possible to achieve organizational objectives.

A systematic literature review and content analysis were carried out to achieve the proposed objective on the obtained portfolio. Such methodologies allowed the achievement of the aim and the elaboration of the conceptual model through the observation of several existing relationships between the themes pointed out by the literature.

It is found that specific blockchain characteristics can enhance certain KM processes. Still, it is impossible to say that all features improve all processes, given that the knowledge acquisition process had no identified relationship with any blockchain characteristic. None of the other processes had a recognized relationship with all the characteristics.

The potential of blockchain, combined with KM, generates impacts such as greater visibility of existing knowledge in the organization, identification of the context in which knowledge was produced, increase in trust for knowledge sharing, providing veracity and authenticity to knowledge, increased security and reducing the risk of loss of knowledge, among others.

It is also possible to verify in the literature that all KM processes, to a greater or lesser extent, generate impacts on the dimensions of sustainability. Examples of these impacts can be seen in issues such as increased customer satisfaction, better staff retention, and improved efficiency and consistency of workflows, such as improving the organization's innovation process, maintaining competitive advantage, and awareness—the anticipation of stakeholder reactions to its performance.

But in addition to the results obtained, this research also has some limitations, many of which can be the subject of future research.

One of the limitations is that the research involves three completely different and complex themes but interconnected, which is necessary to limit the systematic review of the literature with the search for data on only two bases: Scopus and Web of Science limit the amount of data obtained. There is also a limitation regarding the temporality of the research regarding the evolution of blockchain technology and its characteristics, which limits the validity time of the research, which was carried out based on the current attributes of the technology. Also, about blockchain, the potential risks of adopting the technology were not considered, and negative aspects of the existing relationships between the themes were not considered in the research.

For future studies, in addition to the research opportunities generated by the limitations above, it is also possible to advance the study by carrying out proofs of concept or the study of the model by its application in cases, as well as the complementation of the methodological procedures with techniques such as survey and panel with experts.

REFERENCES

AKHAVAN, P. et al. (2018), “Developing a block-chained knowledge management model (BCKMM):

beyond traditional knowledge management." In: Akhavan, Peyman, Philsoophian, Maryam, Rajabion, Lila, Morteza Namvar. *Developing a Block-Chained Knowledge Management Model (BCKMM): Beyond Traditional Knowledge Management*, The 19th European Conference on Knowledge Management (ECKM 2018), September, Italy. DOI: https://doi.org/10.1108/vjikms-08-2017-0051

BANSAL, P. (2005), "Evolving sustainably: A longitudinal study of corporate sustainable development," *Strategic management journal,* Vol. 26, No. 3, pp. 197-218. DOI: https://doi.org/10.1002/smj.441

BANSAL, P. (2002), "The corporate challenges of sustainable development", *Academy of Management Perspectives*, Vol. 16, No. 2, p. 122-131. DOI: https://doi.org/10.1002/smj.441

BARDIN, L. (1977), "Content Analysis". Lisbon: editions, Vol. 70, pp. 225.

BAUMGARTNER, R.J., EBNER, D. (2010), "Corporate sustainability strategies: sustainability profiles and maturity levels", *Sustainable Development,* Vol. 18, No. 2, pp. 76-89. DOI: https://doi.org/10.1002/sd.447

BAUMGARTNER, R.J. (2014), "Managing corporate sustainability and CSR: A conceptual framework combining values, strategies and instruments contributing to sustainable development", *Corporate Social Responsibility and Environmental Management*, Vol. 21, No. 5, p. 258-271. DOI: https://doi.org/10.1002/csr.1336

BECK, R. (2018), "Beyond bitcoin: The rise of blockchain world". *Computer*, Vol. 51, No. 2, p. 54-58. DOI: https://doi.org/10.1109/mc.2018.1451660

BECK, R. et al. (2018), "Governance in the blockchain economy: A framework and research agenda", *Journal of the Association for Information Systems*, Vol. 19, No. 10, p. 1.

BHATT, G.D. (2001), "Knowledge management in organizations: examining the interaction between technologies, techniques, and people", *Journal of knowledge management*, Vol. 5, No. 1, pp. 68-75. DOI: https://doi.org/10.1108/13673270110384419

BUTLER, Y. (2000), "Knowledge management-if only you knew what you knew", *The Australian Library Journal*, Vol. 49, No. 1, pp. 31-43. DOI: https://doi.org/10.1080/00049670.2000.10755905

CLARKE, T. (2001), "The knowledge economy". Education+ Training.

DE LONG, D.W. and FAHEY, L. (2000), "Diagnosing cultural barriers to knowledge management", *Academy of Management Perspectives*, Vol. 14, No. 4, pp. 113-127. DOI: https://doi.org/10.5465/ame.2000.3979820

DEMAREST, M. (1997), "Understanding knowledge management", *Long Range Planning*, Vol. 30, No. 3, pp. 374-384. DOI: https://doi.org/10.1016/s0024-6301(97)90250-8

DUNPHY, P. and PETITCOLAS, F.A.P. (2018), "A first look at identity management schemes on the blockchain", *IEEE Security & Privacy,* Vol. 16, No. 4, pp. 20-29. DOI: https://doi.org/10.1109/msp.2018.3111247

DYLLICK, T., HOCKERTS, K. (2002), "Beyond the business case for corporate sustainability", *Business strategy and the environment*, Vol. 11, No. 2, pp. 130-141. DOI: https://doi.org/10.1002/bse.323

GRONAU, N. and WEBER, E. (2004), "Management of knowledge intensive business processes", In: *International Conference on Business Process Management.* Springer, Berlin, Heidelberg, p. 163-178. DOI: https://doi.org/10.1007/978-3-540-25970-1_11

HIGGINS, J.P.T. and GREEN, S. (2019), "Cochrane handbook for systematic reviews of interventions", *John Wiley & Sons.*

HU, S. et al. (2018), "Reputation-based distributed knowledge sharing system in blockchain", In: *Proceedings of the 15th EAI International Conference on Mobile and Ubiquitous Systems:* Computing, Networking and Services, pp. 476-481. DOI: https://doi.org/10.1145/3286978.3286981

HUGHES, L. et al. (2019), "Blockchain research, practice and policy: Applications, benefits, limitations, emerging research themes and research agenda", *International Journal of Information Management,* Vol. 49, p. 114-129. DOI: https://doi.org/10.1016/j.ijinfomgt.2019.02.005

JAMALI, D. (2006), "Insights into triple bottom line integration from a learning organization perspective", *Business Process Management Journal,* Vol. 12, No. 6, pp. 809-821. DOI: https://doi.org/10.1108/14637150610710945

KEWELL, B. et al. (2017), "Blockchain for good?", *Strategic Change,* Vol. 26, No. 5, pp. 429-437. DOI: https://doi.org/10.1002/jsc.2143

KLUSKA, R.A. et al. (2018), "A new methodology for Industrial Engineering research: Fast Systematic Literature Review", *The 9th International Conference on Production Research.*

KRAUSE, M.G. et al. (2019), "Showcasing knowledge: The promotion of knowledge management in a technology-based organization", *Knowledge and Process Management,* Vol. 26, No. 4, pp. 299-307. DOI: https://doi.org/10.1002/kpm.1602

KWAN, M.M. and BALASUBRAMANIAN, P. (2003), "KnowledgeScope: managing knowledge in context", *Decision Support Systems*, Vol. 35, No. 4, pp. 467-486. DOI: https://doi.org/10.1016/s0167-9236(02)00126-4

LANG, J.C. (2001), "Managerial concerns in knowledge management", *Journal of knowledge management.*

LIN, I.C.; LIAO, T.C. (2017), "A survey of blockchain security issues and challenges", *International Journal of Network Security,* Vol. 19, No. 5, pp. 653-659.

LUBIN, D.A. and ESTY, D.C. (2010), "The sustainability imperative", *Harvard Business Review*, Vol. 88, No. 5, pp. 42-50.

MARCONI, M.A. and LAKATOS, E.M. (2003), "Fundamentos de metodologia científica", 5 ed. São Paulo: Atlas.

MEIRIÑO, M.J. et al. (2019), "Blockchain technology applications: a literature review", *Brazilian Journal of Operations & Production Management,* Vol. 16, No. 4, pp. 672-684. DOI: https://doi.org/10.14488/bjopm.2019.v16.n4.a12

MENDLING, J. et al. (2018), "Blockchains for business process management-challenges and opportunities", *ACM Transactions on Management Information Systems* (TMIS), Vol. 9, No. 1, pp. 1-16.

MUTHUVELOO, R. et al. (2017), "The impact of tacit knowledge management on organizational performance: Evidence from Malaysia", *Asia Pacific Management Review*, Vol. 22, No. 4, pp. 192-201. DOI: https://doi.org/10.1016/j.apmrv.2017.07.010

OLNES, S. et al. (2017), "Blockchain in government: benefits and implications of distributed ledger technology for information sharing", *Government Information Quarterly*, Vol. 34, No. 3, pp. 355-364. DOI: https://doi.org/10.1016/j.giq.2017.09.007

PINTO, C. (2020), "Knowledge management as a support for supply chain logistics planning in pandemic cases", *Brazilian Journal of Operations & Production Management,* Vol. 17, No. 3, p. 1-11.

PROBST, G. et al. (2002), "Knowledge management: the building blocks of success". Bookman Editora.

PROBST, L. et al. (2016), "Blockchain applications & services", *Business Innovation Observatory, Brussels: European Commission.*

RAGHU, T.S. and VINZE, Ajay. (2007), "A business process context for Knowledge Management", *Decision Support Systems,* Vol. 43, No. 3, p. 1062-1079. DOI: https://doi.org/10.1016/j.dss.2005.05.031

RICHARDSON, R. J. (1999), "Pesquisa social: métodos e técnicas". Atlas.

STEURER, R. et al. (2005), "Corporations, stakeholders and sustainable development I: a theoretical exploration of business-society relations", *Journal of Business Ethics*, Vol. 61, No. 3, pp. 263-281. DOI: https://doi.org/10.1007/s10551-005-7054-0

TZORTZAKI, A. M. and MIHIOTIS, A. (2014), "A review of knowledge management theory and future directions", *Knowledge and Process Management,* Vol. 21, No. 1, p. 29-41.

WHITE, G.R.T. (2017), "Future applications of blockchain in business and management: A Delphi study", *Strategic Change*, Vol. 26, No. 5, p. 439-451. DOI: https://doi.org/10.1002/jsc.2144

WIIG, K.M. (1999), "What future knowledge management users may expect", *Journal of Knowledge Management.* DOI: https://doi.org/10.1108/13673279910275611

WÜST, K. and GERVAIS, A. (2018), "Do you need a blockchain?", In: *2018 Crypto Valley Conference on blockchain Technology* (CVCBT). IEEE, p. 45-54. DOI: https://doi.org/10.1109/cvcbt.2018.00011

YANG, L. (2019), "The blockchain: State-of-the-art and research challenges", *Journal of Industrial Information Integration*, Vol. 15, p. 80-90.

YANG, W. et al. (2018), "Blockchain: Trends and future", In: *Pacific Rim Knowledge Acquisition Workshop*. Springer, Cham, p. 201-210.

YEE, Y.M. et al. (2019), "Back to basics: building a knowledge management system", *Strategic*

Direction, Vol. 35, No. 2, p. 1-3.

YEOH, P. (2017), "Regulatory issues in blockchain technology", *Journal of Financial Regulation and Compliance.*

YUAN, Y.; WANG, F-Y. (2018), "Blockchain and cryptocurrencies: model, techniques, and applications", *IEEE Transactions on Systems, Man, and Cybernetics: Systems,* Vol. 48, No. 9, p. 1421-1428. DOI: https://doi.org/10.1109/tsmc.2018.2854904

ZHENG, Z. et al. (2018), "Blockchain challenges and opportunities: A survey", *International Journal of Web and Grid Services,* Vol. 14, No. 4, p. 352-375.

ZHENG, Zibin et al. (2017), "An overview of blockchain technology: Architecture, consensus, and future trends", In: *2017 IEEE International Congress on Big Data (BigData Congress)*. Ieee, p. 557-564. DOI: https://doi.org/10.1109/bigdatacongress.2017.85

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APPENDIX A – Unquoted portfolio articles

RISIUS, Marten; SPOHRER, Kai. A Blockchain Research Framework: What We (don't) Know, Where We Go from Here, and How We Will Get There. Business & Information Systems Engineering, v. 59, n. 6, p. 385 - 409. 2017.
BHATT, Ganesh D. Organizing knowledge in the knowledge development cycle. Journal of knowledge management, v. 4, n. 1, p. 15-26, 2000.
DAVENPORT, Thomas H.; DE LONG, David W.; BEERS, Michael C. Successful knowledge management projects. Sloan management review, v. 39, n. 2, p. 43-57, 1998.
MCINERNEY, Claire. Knowledge management and the dynamic nature of knowledge. Journal of the American society for Information Science and Technology, v. 53, n. 12, p. 1009-1018, 2002.
QUINTAS, Paul; LEFRERE, Paul; JONES, Geoff. Knowledge management: a strategic agenda. Long range planning, v. 30, n. 3, p. 385-391, 1997.
SHARIQ, Syed Z. Knowledge management: an emerging discipline. Journal of knowledge management, v. 1, n. 1, p. 75-82, 1997.
WIIG, Karl M. Knowledge management: an introduction and perspective. Journal of knowledge Management, v. 1, n. 1, p. 6-14, 1997.
BAUMGARTNER, Rupert J.; RAUTER, Romana. Strategic perspectives of corporate sustainability management to develop a sustainable organization. Journal of Cleaner Production, v. 140, p. 81-92, 2017.
CARBALLO-PENELA, Adolfo; CASTROMÁN-DIZ, Juan Luis. Environmental policies for sustainable development: an analysis of the drivers of proactive environmental strategies in the service sector. Business Strategy and the Environment, v. 24, n. 8, p. 802-818, 2015.
EPSTEIN, Marc J.; BUHOVAC, Adriana R.; YUTHAS, Kristi. Managing social, environmental and financial performance simultaneously. Long range planning, v. 48, n. 1, p. 35-45, 2015.
HØGEVOLD, Nils M. *et al.* Sustainable business models. Baltic Journal of Management, v. 9, n. 3, p. 357-380, 2014.
LOZANO, Rodrigo; HUISINGH, Don. Inter-linking issues and dimensions in sustainability reporting. Journal of cleaner production, v. 19, n. 2-3, p. 99-107, 2011.
MEBRATU, Desta. Sustainability and sustainable development: historical and conceptual review. Environmental impact assessment review, v. 18, n. 6, p. 493-520, 1998.
MONTABON, Frank; PAGELL, Mark; WU, Zhaohui. Making sustainability sustainable. Journal of Supply Chain Management, v. 52, n. 2, p. 11-27, 2016.

APPENDIX B – Search results in the databases