REVIEW ARTICLE

Toward a collaborative governance model for distributed ledger technology adoption in organizations

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Abstract

Distributed ledger technology (DLT) is one of the emerging technologies adopted in organizations. Unlike traditional databases, the integrity of the DLT is maintained automatically by an algorithmic consensus mechanism and not by any dominant authority. Thus, the consensus mechanism controls the decision-making and governance process. But the adoption of DLT is faced with issues regarding how to ensure that governance decisions in distributed ledger systems in the interest of all actors and stakeholders involved in the operations of organizational operations. Therefore, it is imperative to provides a better understanding of the governance of DLT adoption in organizations. Accordingly, this study conducts an extensive literature review to investigate the governance issues and control of DLT adoption in intra-organizational domain. Findings from this study presents state-of-the-art governance practices to offer a comprehensive understanding on key governance issues in organizations. Additionally, the findings present factors associated with governance of DLT adoption solutions. More importantly, a governance model is developed to enhance the adoption of DLT adoption to accelerate the digitalization of organizational operations.

Keywords Emerging technologies · Disruptive technologies · Governance of blockchain · Governance of distributed ledger technology · Decentralized governance · Intra-organizational collaboration

1 Introduction

The concept of intra-organizational collaboration has lately been employed in industries to embody high-level cooperation between different departments within an enterprise (Browne and Zhang 1999; Jagdev and Thoben 2001). Intra-organizational collaboration denotes two or more divisions that desire to extend their operations to other industries toward improving their competitiveness and enhancing their existing resources (Al Hadidi and Baghdadi 2019). It involves a type of collaboration where businesses contribute their individual resources to address business problems (Zavolokina et al. 2020; Anthony Jnr 2021a). These departments engaged collaboratively in the design, development, distribution, and production of services to clients. Intra-organizational collaboration aims to address unreliable and

inconsistent data stored by several units in remote databases, incurred cost faced within business processes, and lack of trust and transparency between stakeholders (Zavolokina et al. 2020; Jnr 2020a).

Organizations are currently adopting distributed ledger technology (DLT) to develop novel business goals. The implementation of DLT is changing organizational processes and the way these businesses transact across borders, enabling companies to collaborate outside the reach of current regulations and governance mechanism (Hooper and Holtbrügge 2020; Jnr 2020b). DLT is often referred to as a revolutionary innovation which can create new business models for enterprises. With the development of Bitcoin by Satoshi Nakamoto the international community became aware of DLT as a digital infrastructure that is not governed by a dominant authority (Dutta et al. 2020). DLT improves trust between nodes in a public (open) or private (closed) decentralized approach via the distribution of ledgers data of transactions among the connected nodes (Linkov et al. 2018a, b). This disruptive invention has the capability to transform organizational operations toward digital transformation as it aids integration with legacy systems deployed

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within the organization. DLT has been previously adopted for long-term preservation and the archival records of real estate records, life insurance policies, health-care records, etc. (Franks 2020). DLT adoption in organizations reduces the possibility for data manipulation, theft, and fraud, and enables cheaper, faster, and safer exchange of data in a way that reduces the need for a dominant authority to manage business transactions (Trump et al. 2018a).

Presently, the adoption of DLT in organizations is faced with challenges, including scalability, lack of regulations and standards, security risks, interoperability, governance, and others (Franks 2020). DLT governance problem arouse due to increase in centralization which grants certain control to actors deploying the distributed infrastructure. DLT allows participants and businesses to perform trusted transactions between anonymous parties without recourse to authorities or intermediaries. This shift away from dependence on trusted central authority presents major challenges to traditional mechanisms for governing emerging technologies (Benedict 2019). Thus, irrespective of the benefits of DLTs, if the governance of DLT is not correctly deployed, the performance and security of DLT will be negatively affected. However, findings from the literature stated that DLT platforms such as Bitcoin employs incentives and cryptography to offer transactional integrity, supports decentralized governance without the central governance of any authorities (Benedict 2019). It is required to employ governance approach for DLT that helps to manage the control of nodes users within the distributed network (Nicolae-Bogdan-Cristian et al. 2020).

But as organizations continues to grow technologically, their ability to deal with a heterogeneity and homogeneity of knowledge and level of uncertainties is still an issue. Emerging technologies such as DLTs challenge existing governance practices. Hence experts, regulators, and policymakers are poised to design adaptive, prospective, and knowledge-driven governance strategy for a digital world (Linkov et al. 2018a, b). Researchers such as Howell and Potgieter (2019) stated that there is fewer documented evidence so far on the governance of DLT platforms. But, even if digital platforms such as DLTs are neither owned by anyone particular entity. Findings from a recent study Naudts et al. (2021) suggested that the governance of DLTs are more challenging due to their decentralized nature which is different from centralized approach employed by traditional organizations. The literature discussing governance of DLTs has so far mainly focused on fintech and cryptocurrencies (Seyedsayamdost and Vanderwal 2020). Hence, there is need to provide recommendations governing DLTs such as blockchains operation which must be assumed by some actors (Howell and Potgieter 2019). Likewise, more research is needed to better understand the governance structures of DLT (Seyedsayamdost and Vanderwal 2020). Therefore, this study

adds to a more substantiated discussion regarding DLT in organizational domain by exploring the following research objectives.

- To identify the state-of-art for governance of DLTs in organizations.
- To explore the current practice of DLT governance in organizations.
- To examine the governance typology for DLT adoption in organizations.
- To investigate the factors that inhibit the governance of DLT in organizations and further propose a model and propositions.

Therefore, this article adds to the body of knowledge by proving descriptive evidence on the governance of DLT in organizations. Moreover, this study identifies DLT governance factors and provides suggestions on how DLT governance can be improved in organizations. This paper is structured as follows. In the next section, the literature review is presented followed by the method employed in Sect. 3. Then the findings and discussions are presented in Sect. 4. Section 5 highlights the recommendations and implications. Finally, the conclusions are presented.

2 Literature review

This section discusses on emerging technologies and provides the need for this study. Also, prior studies that examined the governance of DLT in the literature are presented.

2.1 Governance of emerging technologies in organizations

Emerging technologies promise innovative benefits for humanity and the natural environment (Linkov et al. 2018a, b). Emerging technologies are also key driver of scientific and industrial progress as they enable practitioners and researchers to produce exciting and new breakthroughs in diverse domains (Trump et al. 2018c). Accordingly, the adoption of emerging technologies is changing organizational operations by improving connectivity, communication, trade, and services. While the development of a digital economy may improve productivity, use of emerging technologies also creates potential social sustainability challenges pertaining to the risk and governance caused by emerging technologies such as big data, artificial intelligence, distributed ledger technologies, industry 4.0, digital twins, internet of things, and so on. (Linkov et al. 2018a, b). Although there are many emerging technologies, this current study is more aligned to governance of DLTs which is one of the emerging disruptive digital technologies.

Over the years, various approaches have been proposed to promote the governance of emerging technologies toward sustainable digitalization (Linkov et al. 2018a, b). There are still many perspectives of how DLT is currently being governed primarily in within and across organizations. Existing literature on governance of DLTs is still in the exploratory phase. But there is need for further research in this area due to uncertainty regarding governance approach for rulemaking and reform within the distributed ledger network. Additionally, the potential stakeholders within these networks need to be specified (Whitford and Anderson 2021). In practice, different stakeholder opinions regarding the adoption of emerging technologies in organizations and the society at large may hinder the path toward emerging technologies attaining their benefits (Keisler et al. 2021). Hence, there is a growing gap between the level of innovation in emerging technologies and the rate of effective governance and regulation pertaining to these digital technologies.

Mostly, at the organizational level, stakeholders face decision difficulties with their organization's salient values, motivations, and missions (Keisler et al. 2021), in relation to the adoption of emerging technologies such as DLT. This creates governance challenges to organizations which adopts DLTs necessitating the need to better identify emerging technologies governance components to address considerations ranging policymaking for risk management (Florin 2011; Trump et al. 2018c). Current practices for emerging technologies such as DLTs must emphasize adaptive and proactive approaches to governance and risk management (irgc 2017). Such efforts call for complete investigation to develop new and holistic approaches for governing emerging technologies, i.e., DLTs such as blockchain, holochain, directed acyclic graph (DAG), hashgraph, and Bitcoin's adoption in organizations. Ultimately, a governance method for emerging technologies (such as DLTs) will assist with the risk-based frameworks used by regulators and other experts by accounting by providing a comprehensive view, comparative assessment, guidance and also opens up new opportunities for emerging technologies adoption in organizations. This will iteratively improve risk assessment (Florin and Jianhua 2014; Federal Office for the Environment 2015) and support democratic decision-making on governing of risk assessment/management related to the adoption of emerging technologies such as DLTs (Linkov et al. 2018a, b).

2.2 Related works

DLT governance has become an issue in organizations as such a few studies have been focused on addressing governance issues in distributed ledger systems over the past years. One of these studies was conducted by Naudts et al. (2021) where the authors carried out a comparative study on governance within systems based on DLT in financial industries. The study focused to discover the potential benefits and associated risks linked to financial markets. Franks (2020) conducted a comprehensive literature review to provide an understanding of the issues faced by their organizational adoption of blockchain DLT. The study provided implications on the application of blockchain DLT for information governance programs and records management. Nicolae-Bogdan-Cristian et al. (2020) explored how to achieve an efficient governance with DLTs based on a various type of nodes, usually fitted out with more high computational resources. The authors attempted to demonstrate the relevance of democratic governance within blockchain ecosystem via the use of super nodes to address the governance issues.

Additionally, Howell and Potgieter (2019) explored the governance of DLT and blockchain. The authors adopted an institutional analysis for development model to investigate the psychological, technological, economic, social, and political perspectives in which DLT platforms are deployed to understand the operating governance within various levels of interaction. Benedict (2019) presented the challenges faced by DLT-based systems to highlight the challenges to institutionally oriented governance. The authors explored how standards can resolve the guarantees lost by the dislocation of traditional institutional governance mechanisms deployed in DLT platforms Besides, Liu et al. (2019) presented a decentralized blockchain oriented data governance. Their study is grounded on data governance approach developed on blockchain-based decentralized services. The study offered key insights and presented novel technologies and challenges as related to intelligence, interoperability, and programmability.

Another study by Zachariadis et al. (2019) explored the control and governance of distributed ledgers and provided an understanding of the challenges facing blockchain systems in financial industries. The study examined current governance methods of popular or established blockchain and decentralized autonomous organization (DAO) platforms with a view to identify how the DAO managed the governance crises especially around accountability and control. Another interesting study by Trump et al. (2018b) investigated governing the utilization of DLT and blockchain. The study aimed to explore who ought to have access to data within a DLTs, and whether DLT system should be restricted or permissioned, while exploring key governance concerns and application of DLT within organizations. Calleja López et al. (2017) published a project deliverable that discussed on DLT governance. Their deliverable presented a model for support the democratic governance of DLTs which is part of a decentralized citizen-based data ecosystems. The deliverable provided a comprehensive analysis of democratic governance of digital platforms from the perspective of the code, the legal context, and the society.

The reviewed studies investigated governance of DLT and blockchain. Most of the existing literature on governance of DLT are mostly not aligned to governance of blockchain adoption in financial sector (Zachariadis et al. 2019; Naudts et al. 2021). But none of the reviewed studies explored governance of DLT adoption in departments within organizations that collaborates to achieve similar goals. This gap in knowledge and the practical significance highlights the motivation for this current research. Therefore, there is need for a study that fills this gap in knowledge which explores governance decisions in distributed ledger systems adoption in organizations.

3 Methods

A systematic literature review was carried out based on the approach by Anthony Jnr (2021b). A systematic literature review aims to expediently assess prior studies that are appropriate to the specific research topic to present a fair assessment of an investigated topic using a rigorous and trustworthy approach. Therefore, the research flow for this study comprises of five phases as shown in Fig. 1.

Figure 1 shows the research flow for this study, where each phase is discussed below in the subsequent subsections.

3.1 Inclusion and exclusion criteria

The inclusion and exclusion criteria are the sampling approach employed to select peer-reviewed articles to explore governance of distributed ledger technologies adoption in organizations. The inclusion and exclusion criteria are stated in Table 1. Thus, peer-reviewed articles and technical reports are included if it meets up to the criteria in the inclusion column and is excluded if it satisfies any of the exclusion criteria.

3.2 Search strategies and data sources

The sources employed in this study were retrieved through a comprehensive search of prior governance of DLT in research through online databases which comprise of Google Scholar, Wiley, Taylor & Francis, IGI Global, ScienceDirect, Sage, Emerald, IEEE, ACM, Inderscience, and Springer. The search was undertaken last within February 2022. The search terms include the keywords (("governance of distributed ledger technology" OR "governance structures for emerging technologies" OR "DLT governance" OR "distributed ledger technology governance") AND ("governance of blockchain" OR "blockchain governance" OR "consensus mechanism of DLT" OR "consensus mechanism of distributed ledger technology" OR "consensus mechanism of blockchain" OR
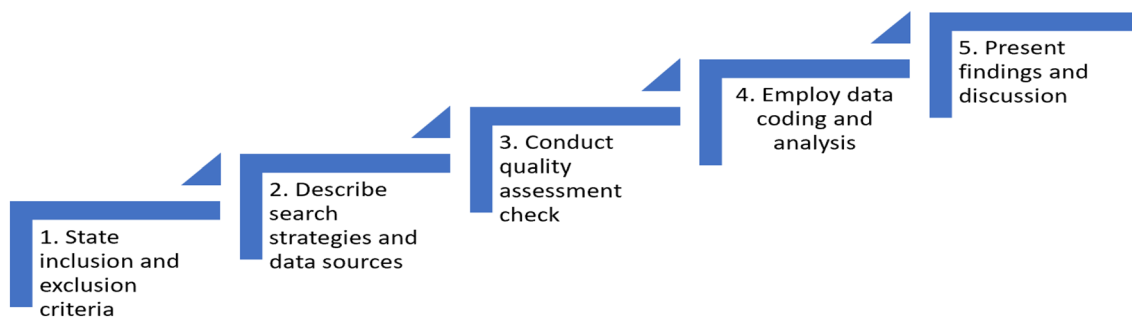

Fig. 1 Research flow

Table 1 Inclusion and exclusion criteria

Inclusion	Exclusion
• Should provide background on the governance of DLT/blockchain in organizations	• Studies that do not present background on the governance of DLT/blockchain in organizations
• Should be based on an approach, model, theory, framework for achieving governance of DLT/blockchain	• Models, approach, frameworks, or theories used in contexts other than governance of DLT/blockchain
• Should be mainly written in English and published between 1999 till date (February 2022)	• Studies not within 1999 till date (February 2022) and are not written in English
• Studied on DLT/blockchain governance, governance categories, governance consensus mechanism, governance challenges, and governance polices	• Studies not on DLT/blockchain governance, governance categories, governance consensus mechanism, governance challenges, and governance polices

"organizations") AND ("governance categories of block-chain" OR "governance categories of distributed ledger technology")). These keywords were employed to retrieve appropriate articles to provide empirical evidence regarding governance of distributed ledger technologies adoption in organizations.

Figure 2 shows the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) flowchart which was used for screening of articles as previously utilized by Anthony Jnr (2021a). The final search resulted to 70 peer-reviewed articles using the keywords above. No articles were established as duplicates. Thus, the articles remained 70. The articles were checked against the inclusion and exclusion criteria and 33 sources were excluded since they were not related to governance of DLT in enterprises resulting to 37 articles. The remaining articles was checked for quality assessment. A check was carried out to verify if the articles were indexed in Scopus or/and ISI Web of Science databases. The findings as discussed in the quality assessment section suggest that the selected studies meet the inclusion and quality assessment criteria. Lastly, 13 articles were included via cross referencing as seen in Fig. 2. All included sources are presented in the reference section of this paper adding to 50 articles.

3.3 Quality assessment

One of the important benchmarks that is required to be checked with the inclusion and exclusion criteria is the quality assessment check as recommended by Anthony Jnr (2021b). Therefore, quality assessment check was employed for all selected peer-reviewed articles to confirm if the papers are indexed in Scopus or/and ISI Web of Science database as previously stated. This criterion helped to evaluate the quality of the selected studies. Besides, more than half of the articles included are indexed in Scopus or/and ISI Web of Science database.

3.4 Data coding and analysis

The selected 50 peer-reviewed articles/technical reports are utilized to provide evidence in response to the governance of distributed ledger technologies adoption in organizations. This helps to provide information on DLT governance
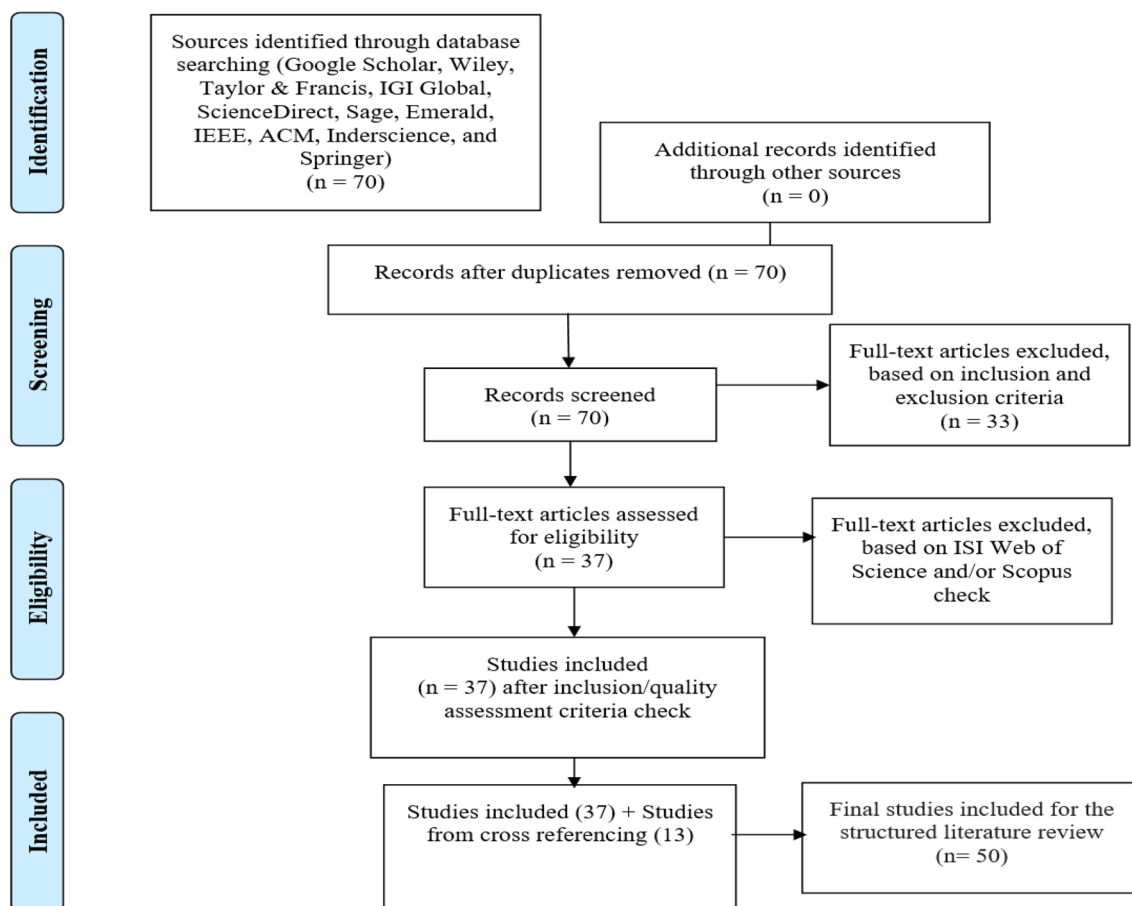

Fig. 2 PRISMA flowchart for the selected articles

dimensions, stakeholder/actors, DLT governance consensus mechanisms, and governance typologies of DLTs. Also, information on the potentials and challenges regarding DLT governance in organizations. Thus, secondary data are extracted and synthesized in detail and evidence from these sources as related to governance of DLT in organizations.

4 Findings

This section provides findings based on the selected 50 peer-reviewed articles included for this study related to governance of DLT adoption in organizations.

4.1 Year of publication, methodology, countries, and contexts

Findings from Fig. 3 indicate that the selected studies ranged from 1999 to 2021. Findings suggest that more studies related to governance of distributed ledger technologies adoption in organizations were published in 2020 as compared with the other years. Some studies are included in the period 1999–2004 even if documentation of DLT starts after 2008. These included studies relate to intra-organizational collaboration.

Considering the methodology applied in selected studies, findings from Fig. 4 show that literature review studies are the most employed method (N = 17). Next are studies based on conceptual grounded is with (N = 12). Following are studies that employed case study and document review for validation (N = 4), respectively, and studies that are based on survey and interview with (N = 3), respectively. Another two studies (N = 2) employed use case application

to illustrate the governance of DLT. The remaining studies (N = 1) employed other methods as seen in Fig. 4.

Regarding the studies, the country distribution of all authors in terms of the frequency is illustrated in Fig. 5. The findings suggest that most of the authors that researched on governance of distributed ledger technologies adoption in organizations are based in the United States of America, Switzerland, The Netherland United Kingdom, Norway, Germany, and Australia as compared to other countries. The numbers represented in Fig. 5 are, however, higher than 50 as most articles have more than one authors from different countries. Considering the selected studies' context distribution for governance of distributed ledger technologies adoption, the findings as seen in Fig. 6 suggest that most studies investigated governance of blockchain and DLT, emerging technologies, and adoption of DLT/blockchain technologies. Likewise, Fig. 7 show the distribution of selected research context, where most of the selected studies on the governance of DLT are more aligned to general context, emerging technologies, and risk governance. This shows there is need for studies that examines governance of DLT in organizations. Therefore, this current study adds to the existing body of knowledge by investigating governance of DLT adoption in organizations.

4.2 Current state of distributed ledger technology adoption in organizations

Presently, several departments within organizations form a type of partnership or alliance of two or more individuals or units with the objective of partaking in a common activity by pooling their resources for attaining a common goal (Jnr 2020b). This can be seen as a traditional form of
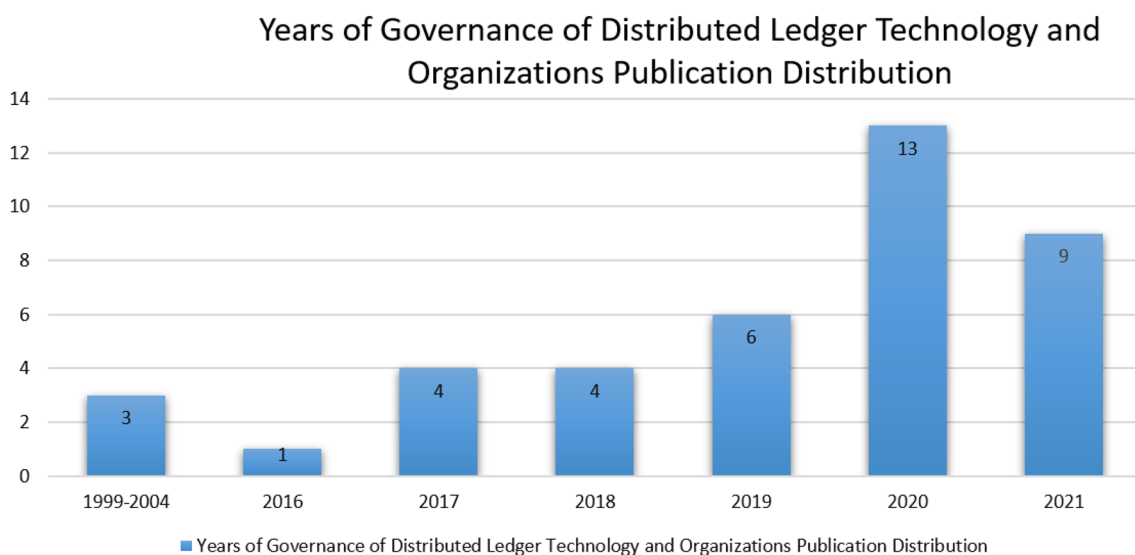
Fig. 3 Distribution of governance of DLT and organizations articles in years
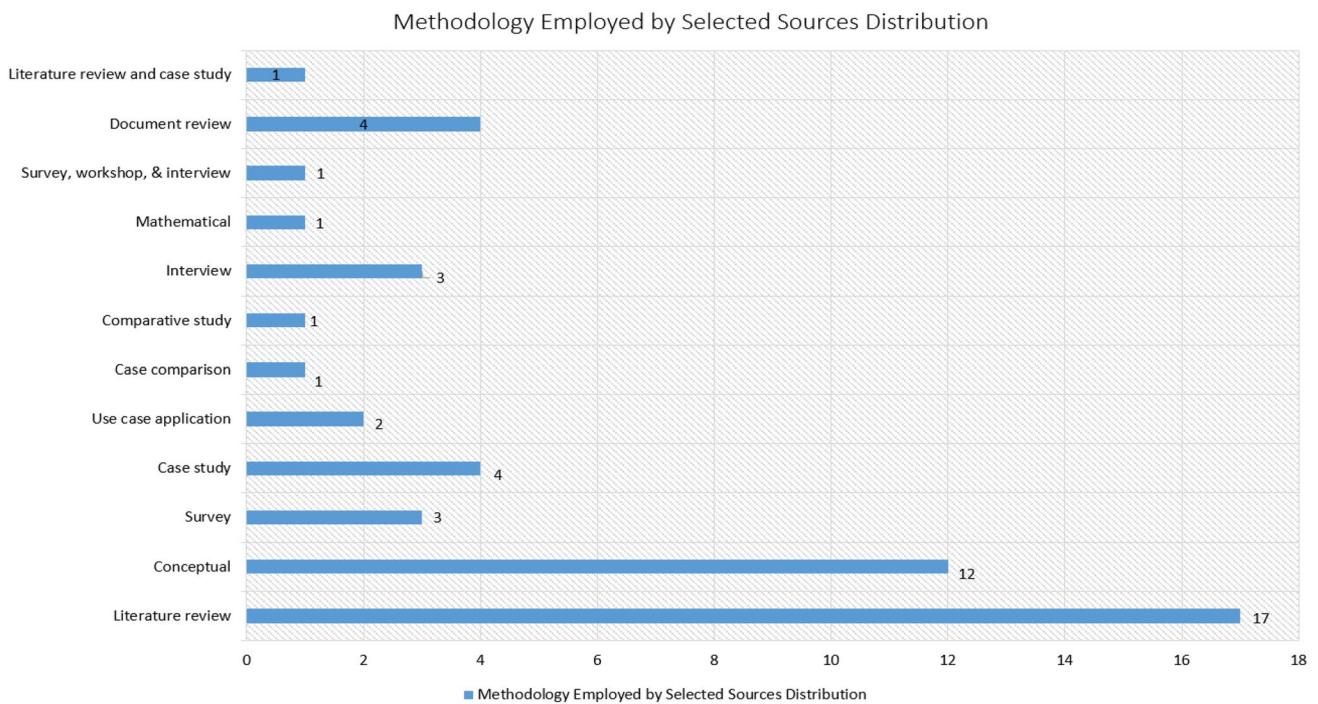
**Fig. 4** Distribution of selected articles in terms of methodology

collaboration between businesses that generate value by sharing know-how and resources to save costs (Zavolokina et al. 2020; Lai et al. 2021). DLT is now adopted by these organizations, where a distributed ledger is a file or database distributed across numerous computing devices or node users. Each individual node user within the distributed ledger network has access to an identical digital version of the complete ledger. DLT acts as a digital public ledger that is transforming traditional enterprise operations by streamlining business processes, enhancing trust, and saving costs and time for companies. Its adoption is disrupting the status quo and inspiring innovative medium of improving business in many sectors (Hooper and Holtbrügge 2020). DLT has been adopted as an innovative approach of storing and managing data within and between businesses such as organizations toward supporting their capability to adapt to digital transformation change and communication with digital platforms (Pelt et al. 2021).

DLT stores data on a network of different machines, with changes to the distributed ledger reflected concurrently for all machines in the distributed ledger infrastructure. DLT employs authentication via cryptographic signature (Deshpande et al. 2017). Unlike traditional databases, the distributed ledger is not managed by any dominant authority (Howell and Potgieter 2019; Rajnak and Puschmann 2020). In organizational context, governance refers to the administration of powers, liabilities, and responsibilities regarding the DLT infrastructure in relation to its actors to create a secure, efficient, adaptable, reliable, and sustainable ledger infrastructure (Naudts et al. 2021). Governance decisions within distributed ledger systems is regulated by a small union of core software expert members, who may be hired or also partake as node users and/or be directly associated with a prominent node user. These core software expert members are paid from either their node operations, or from honorarium paid from stakeholders (Howell and Potgieter 2019).

DLT such as blockchain was first adopted in the financial organizations as cryptocurrency and has been used in other enterprises such as in the transportation, insurance, supply chain industry, health care, and so on. (Trump et al. 2018b). DLT systems such as Quorum, Hyperledger Fabric, Corda's R3, or the Libra blockchain (Chen et al. 2020; Auer et al. 2021) can support organizations to improve trust in business transactions without the necessity for third-party mediation giving organizations to control their transactions and data. Findings from the literature suggest that DLT offers a trusted mechanism to exchange data securely with external and internal associations while ensuring data integrity. It aids human-to-human trust that is required in organizations (Deshpande et al. 2017). Organizations such as Nestle are adopting DLTs to improve their supply chain tracking service in Europe to aid customers to track the sourcing of Gerber baby food ingredients. Facebook is another organization that is concerned in adopting blockchain to provide privacy

Distribution of Selected Governance of Distributed Ledger Infrastructure Studies by Country
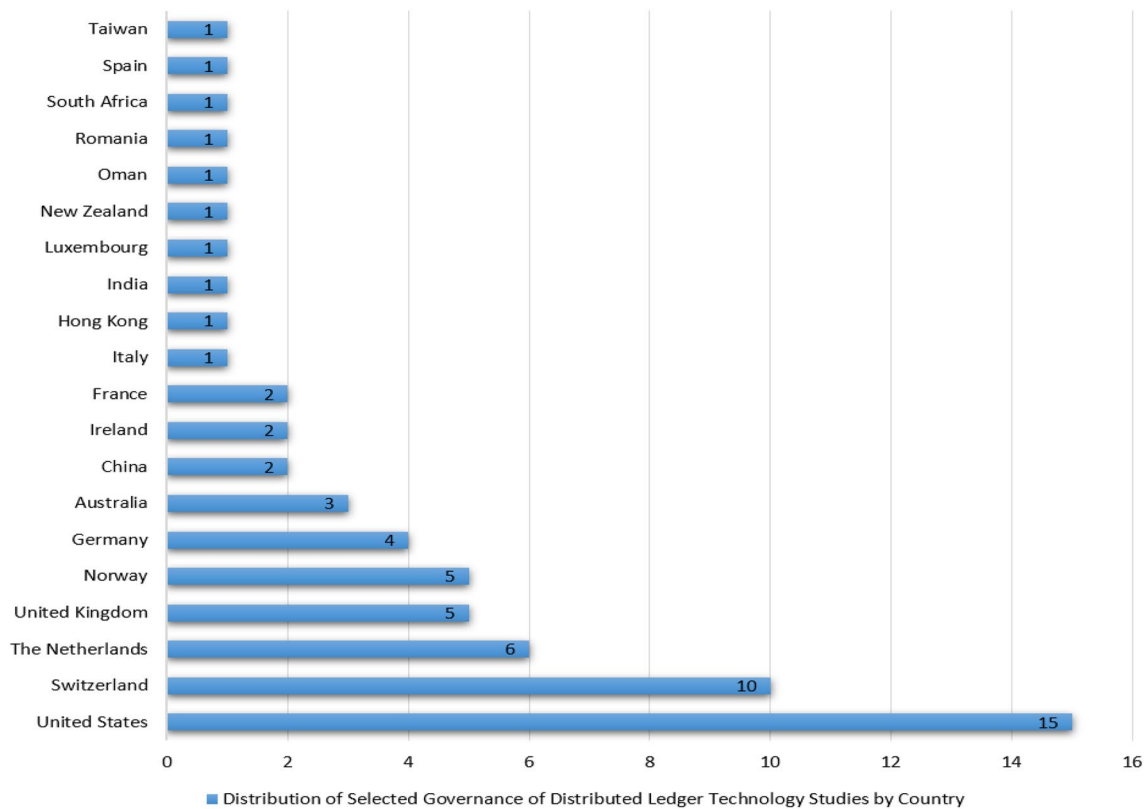
Fig. 5 Distribution of selected studies by country

to its users by deploying blockchain-based identities for log functionalities in Facebook website (Hooper and Holtbrügge 2020).

Another enterprise adopting DLT is Starbucks which tracks coffee production of partner farmers in Rwanda, Colombia, and Costa Rica. DLT is facilitating the firm to test their Bean to Cup program so that prospective customers can trace the of coffee. Bumble Bee which is a sea food company is another business which is adopting DLTs such as blockchain to improve its supply chain management in tracking tuna from the South Pacific to grocery stores located in the United States. (Hooper and Holtbrügge 2020). Also, most organizations that adopt DLTs employs smart contracts which are a set of agreements, stipulated in digital form, comprising protocols within which business partners perform transactions (Meier et al. 2021). Smart contracts are automated digital contract in which the conditions of the transaction are pre-defined in computer code, which are automatically executed by the DLT platform upon confirmation from a particular transaction among partners within organizations.

4.3 Background of governance in organizations

The word "governance" originated from an ancient Greek word "kubernân", and it involves the procedures of interaction and decision-making between different actors involved in a collective process within an institution (Calleja López et al. 2017; Beck et al. 2018; Pelt et al. 2021). Governance refers to the mechanism that resolves organizational accountability, enterprise structure, and shareholder control in interorganizational context (Anthony Jnr 2021b; Whitford and Anderson 2021). It enables partners to execute, oversee, and manage a multifaceted series of cooperating involved among different stakeholders in organizations (DiRose and Mansouri 2018; Zachariadis et al. 2019). Governance aids the assigning of responsibilities, powers, and liabilities regarding the objectives of organizations.

It aims to identify and manage possible risks in a timely and proper manner and helps to protect the interests of all collaborating parties in organizations (Naudts et al. 2021). Governance is a topic that traverses all institutional perspectives across the history of economic and society thought as

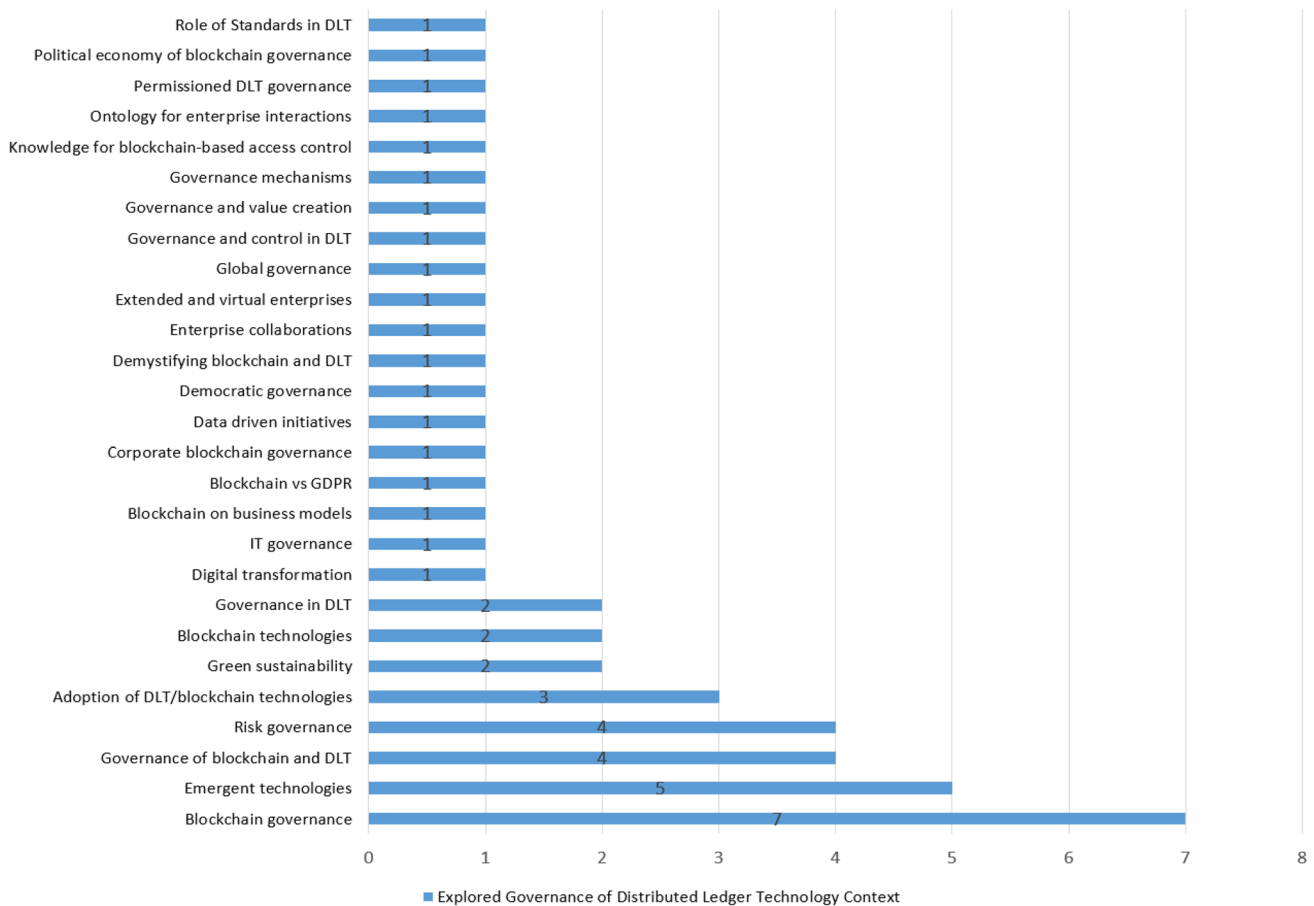## Explored Governance of Distributed Ledger Technology Context

Fig. 6 Distribution of context explored by selected articles

it is an important issue which is employed in organizations to administer policies that manage use of firm resources. As stressed by Naudts et al. (2021), the concept of governance comprises of social, economic, and political issues and is considered from different viewpoints (technological, operational, administrative, and financial) as seen in Fig. 8.

Figure 8 depicts the governance structure in organizations. This current study is more aligned with the *social concept of governance and technological viewpoint of governance*. Governance depicts how organizations manage their common affairs (Seyedsayamdost and Vanderwal 2020). Informally, it entails how the enterprise maximizes the value of data, enabling legal compliance and risk mitigation, improving operational transparency, and decreasing costs incurred (Franks 2020). Based on IT perspective, a governance approach comprises of the processes, policies, roles, and metrics and standards that guarantee the efficient and effective use of IT in enabling organizations to achieve their goals. Overall, governance in organizations should underline which stakeholder makes decision (Weill and Ross 2004), who has contributed to a decision (Zachariadis et al. 2019),

and how all partners are held responsible for their role for proper functioning of the consortium ensuring delivery of competitive gain for all businesses.

4.4 Current practice of DLT governance in organizations

Weill and Ross (2004) describe the governance as the accountabilities and decision rights that administer the use of information technology (IT) in an organization. Governance determines how the DLT platform uses, and access is determined and how different actors will operate the DLT system over the lifetime of the infrastructure without any single owner (Howell and Potgieter 2019). Thus, DLT platforms are deployed as a democratic statutory catallaxy which requires that actors and stakeholders of the distributed ledger infrastructure must be governed based on a set of statutory approach in a way in which all actors deploying the DLT platform participate in the governance of the system (Howell and Potgieter 2019). Governance of distributed ledger systems specifies how decision rights, control, and

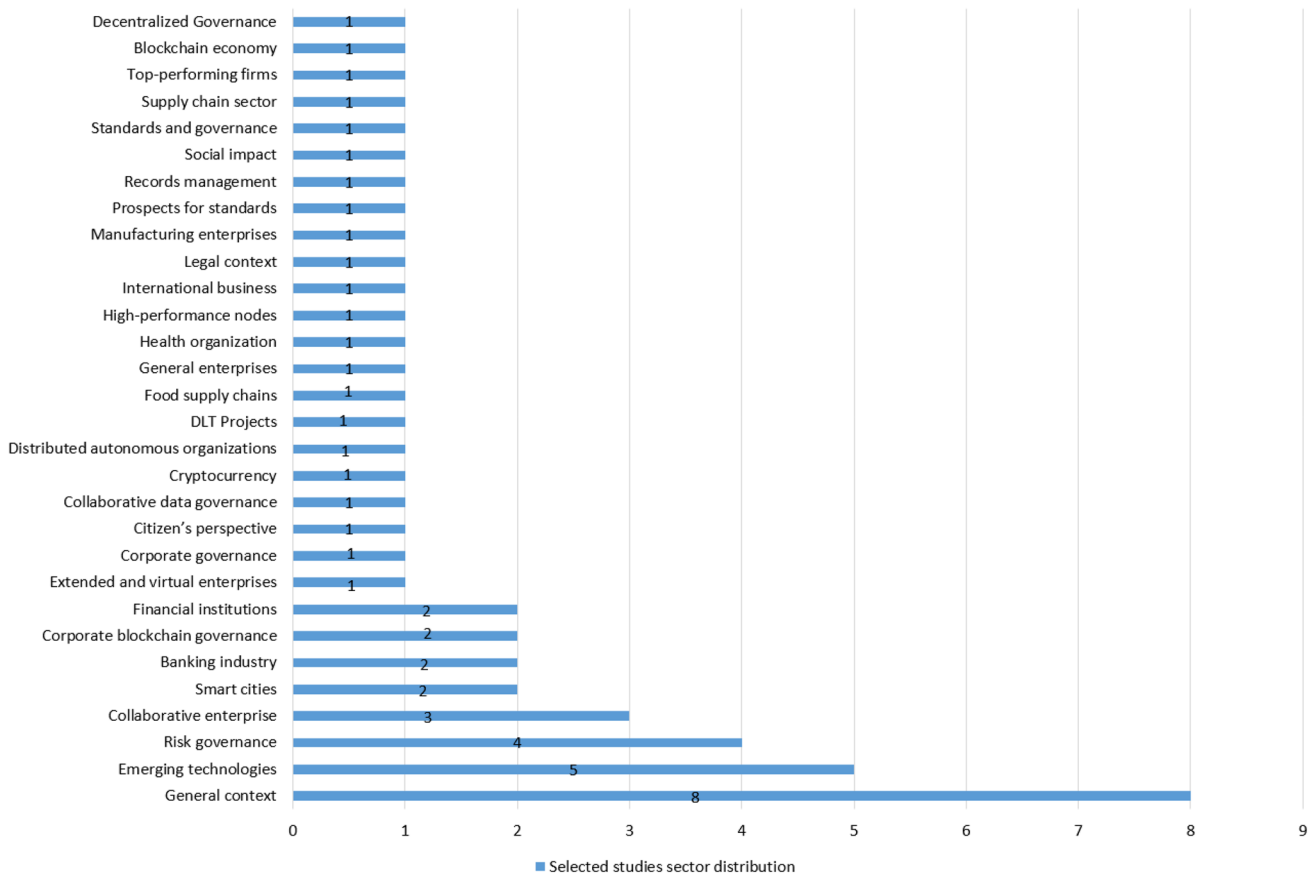Selected Studies Sector Distribution

Fig. 7 Distribution of selected organizations research context

accountability are employed within enterprise process as a framework to support the creation, approval, and access of data. It comprises the roles, policies, processes, metrics, and standards that ensure the efficient and effective use of data in enabling organizations to achieve their set goals (Franks 2020).

The decentralized governance of DLT enables operational scalability beyond the limits of institutionally driven governance. But it is faced with challenges as related to managing

Fig. 8 Governance structure in organizations

risks and ensuring an equitable outcome (Benedict 2019). Zachariadis et al. (2019) mentioned that while opinions about the efficacy and legitimacy of DLT vary dramatically, majority of the adopters of DLTs such as blockchain agreed that one of the major challenges of distributed ledgers infrastructure is linked to governance. Zachariadis et al. (2019) argued that while the technological component makes DLTs impervious to theft or fraud, the direct democratic governance approach is seen as a considerable challenge to achieve sustainability, transparency, and decision-making for future update.

Currently, DLT such as Bitcoin employs a decentralized governance approach whereby update to the DLT infrastructure`s protocol is decided by a consensus of node participants. Although this process usually operates with minimum disruption, at times fixed conflicts between different groups within the DLT's governance procedure can result to a rift among the actors involved in the consensus governance process (Trump et al. 2018a). Such rifts within the governance process poised a challenge that can result to reduce trust and use by organizations. Such issues are particularly evident for scalability of distributed ledgers such
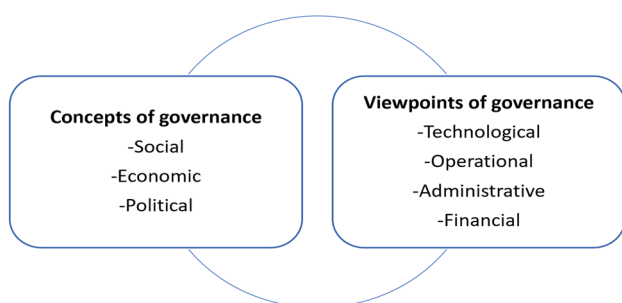
as Bitcoin, Ethereum blockchain, and so on, where software upgrades are required to improve the integrity of transactions carried out by the DLT platform (Trump et al. 2018a).

Furthermore, there is need to understand activities taking place within the ledger toward identifying prospective risks and ensure compliance with existing regulation. Thus, the integrity of the distributed ledger is automatically maintained by an algorithmic consensus mechanism which operates as a governance technique enabling nodes users vote and/or approve upon the updating and versioning of the distributed ledger (Howell and Potgieter 2019). However DLTs are not owned by anyone and its governance is not governed by no one entity (Howell and Potgieter 2019). Researchers such as Deshpande et al. (2017) highlighted that there is uncertainty as regards to understanding the governance of DLT or the development of detailed regulation related to DLT adoption, whereas researchers such as Naudts et al. (2021) maintained that the governance of DLT platforms can be categorized as managerial governance and operational governance.

Naudts et al. (2021) further stated that the managerial governance comprises examining controlling how the DLT infrastructure develops and evolves (how the DLT platform is updated and maintained). In contrast, operational governance entails the control of the technical part of the DLT network (consensus algorithms/mechanism and cryptography). For example, it entails governing the technical operators and systems components that helps the distributed ledger to be functioning. Overall, the adoption of DLT in intra-organizational environment is similar to traditional enterprises that deploy DLT platforms which comprise of nodes/miners and companies who mainly form the governance of the infrastructure (Naudts et al. 2021). Although organizations may not be able to change some pre-existing governance rules embedded within the DLT software which may be difficult and costly to change, resulting to the consortium adhering to institutional rules embedded within the system when they make decisions (Howell and Potgieter 2019).

To this end, Deshpande et al. (2017) highlighted that there is lack of clarity on how DLTs are to be governed. This is based on the distributed and immutable nature of the technology makes it difficult to set out rules and polices for governing DLTs thus require individual actors to interact with the distributed ledger and perform control using their private keys. For distributed ledgers used by organizations, there is also a challenge on how partners can ensure accountability, decision-making, and distribution of incentives among collaborators for the business operations deployed on the ledger. For instance, accountability for losses that may occur in the event of compromised keys due to data loss or theft or even operational failure. Furthermore, organizations which deploy DLT have incentives which are distributed to all partners within the intra-organizational group. They have an economic interest in increasing the demand and supply of their products and services to increase profitability (Ferreira et al. 2019) and control mechanism that administer how the DLT platforms are deployed by partners.

Figure 9 depicts the dimensions that impacts the governance of DLT in organizations. The issue of how best to structure the governance processes has been a recurrent one faced by organizations. This is because the possibility to resolve disagreements, assign decision right, control mechanism, and assess the accountability among businesses towards achieving a consensus among different actors with different incentives is essential to have a functional alliance. This current study provides an understanding of governance and control mechanism in distributed ledger systems. The control mechanisms that organizations will deploy may include guidance on the management and organizational processes that partners are anticipated to adopt, administering rules, holding members accountable, and utilizing metrics, etc. (Zachariadis et al. 2019). In a decentralized governance of DLT, where there is no autocratic administration to make decisions, control mechanisms are more informal and is based on a collaboration process that provides a shared beliefs and common values (Zachariadis et al. 2019).

4.5 Consensus mechanisms of DLT in organizations

As seen in Fig. 9, DLT-based platforms (public and private) are characterized by consensus algorithms or mechanisms (Naudts et al. 2021), which maintains the integrity of the distributed ledger network content usually embedded within the software codes. A consensus mechanisms or algorithm is a method that allows the peers to reach agreement on the authenticity of ledger data, certifying the distributed ledger system and all its actors accept the same data (Nicolae-Bogdan-Cristian et al. 2020). Transactions or new data which eventually changes the distributed ledger content are suggested by a different user class (termed transactors), which may or may not also be a node user. As the distributed ledger
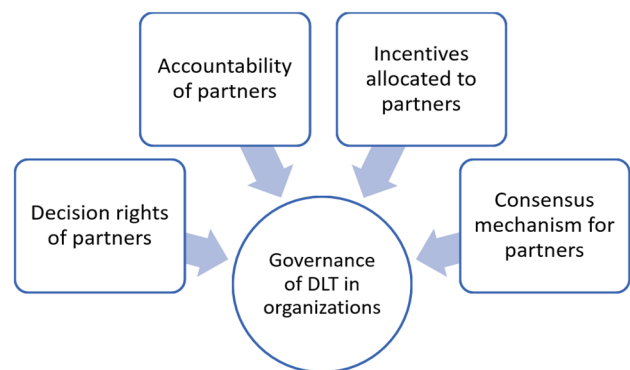

Fig. 9 Dimensions for governance of DLT in organizations

is precisely time-bound, the only modifications permissible are additions (in a blockchain platform, it includes the new addition of links to the existing chain).

Several consensus algorithms are typically employed as protocols to certify the validity of the data or transactions included to the distributed ledger, they include proof of work (PoW) and proof of stake (PoS) (Howell and Potgieter 2019), and others. The PoW consensus algorithm is one of the most employed consensus mechanisms employed in existing DLTs. It was first deployed in Bitcoin to ensure that peers, in particular miners, compete on establishing the authenticity of a block by deciphering a complex mathematical puzzle such as calculating a nonce based on a hashing algorithm. PoW is executed in a distributed ledger network when a node user adds a new data or block in blockchain, the DLT platform employs a PoW algorithm to attain distributed consensus. The PoW algorithm requires that participants within the distributed ledger network solve a sequence of increasingly challenging set of rules known as proof-of-work problems. The first miner or participant who solves the mathematical puzzle is awarded a reward such as a predictable part of the given DLT such as Bitcoin (Howell and Potgieter 2019).

PoW consensus algorithm enables an incentive-based quasi-democratic and distributed method toward DLT development and ledger administration. It is criticized for utilizing a major investment in resources for a broad network of computer systems to solve the proof-of-work problem (particularly electricity) (Trump et al. 2018b). While the PoS is the most frequent substitute to PoW consensus algorithm and mining because it was less complex to employ in DLTs. PoS consensus mechanism is deployed within the distributed ledger network by allocating either randomly or by a particular rule the accountability of authenticating a block to a peer or among a group of peers within the distributed ledger network, thus lessening the need of computational power and energy (Nicolae-Bogdan-Cristian et al. 2020). PoS usually employs a random selection of participants or node users with a substantial ownership of the given DLT to ascertain the next ledger or block (for blockchain). Additionally, as previously stated, they are other consensus algorithms which have been developed to address the issues associated with PoW and PoS and to meet different requirements in the literature such as practical byzantine fault tolerance (PBFT), proof of elapsed time (PoET), direct acyclic graphs (DAGs), proof of authority (PoA), proof of capacity, proof of activity, proof of burn, delegated proof of stake (DPoS), proof of importance, and so on.

## 4.6 Governance typology for DLT adoption in organizations

Findings from the literature (Deshpande et al. 2017; van Pelt 2019; Allen and Berg 2020; Dutta et al. 2020; Franks 2020; Naudts et al. 2021) suggested that DLT can be characterized as either public or private. A publicly governed DLT platform encompasses a network of private individuals (the possible nodes) and companies who contribute out of their own choice to support the operation of the DLT and achieve consensus on transactions and software modifications (Naudts et al. 2021). A public DLT is commonly described as permissionless. It comprises of several stakeholders which can be individuals or group of users (for example users, miners, nodes, and system developers) (Allen and Berg 2020), who participate in the governance or operation of the organizations (Anthony Jnr 2021a).

The publicly governed DLT platform may not be suitable for organizations as it does not support any legal obligations although it facilitates client and merchant relationship based on smart contracts. Also, due to the decentralized and horizontal administrative of publicly governed DLT structure, the execution of strategic decisions regarding business transactions within the distributed ledger and who is responsible for which task may be difficult to carryout (Naudts et al. 2021). Accordingly, the DLT typologies are shown in Fig. 10.

Figure 10 depicts DLT typologies. The permission state is based on the control roles or privileges granted to pseudonymized node users (which are computers within the distributed ledger network), to access transactions and validate transaction as a basis to administer decentralized governance (Beck et al. 2018; Franks 2020; Ziolkowski et al. 2020). Permissioned ledgers are used by closed (public) communities of individuals that have similar but competing pursuits, or they can be private for one or more businesses that share mutual interests (Deshpande et al. 2017), as seen in Fig. 10 and Table 2.

Table 2 depicts the key governance properties of DLT in terms of the three types of DLTs. The permissionless or public-based ledgers are considered as the original form of DLT such as Bitcoin. In permissionless or public-based distributed ledgers node participation is "permissionless" and any enterprise or individual can take part in the distributed ledger network and authenticate transactions, with fully delegated authority mostly based on proof-of-work consensus mechanism. The participants in this DLT are mostly anonymous and identified through pseudonyms. The transactions are authenticated by "miners" via an incentivization mechanism. This type of distributed ledger incurs increased transaction costs because of resource-intensive consensus mechanism employed but promotes high security (Deshpande et al. 2017). Generally, permissionless ledger has no central

Fig. 10 DLT typologies adapted from (Franks 2020)
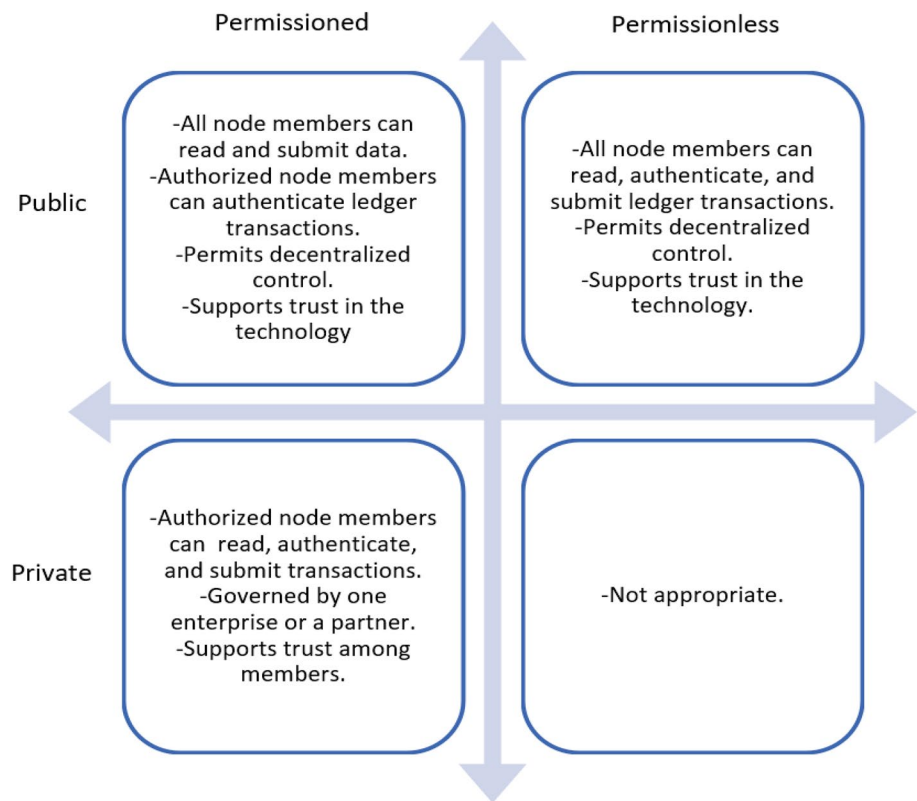
Table 2 DLT topology and associated properties adapted from (Dutta et al. 2020)

| Governance properties	Public permissionless	Public permissioned	Private permissioned
DLT control	Fully decentralized	Fully decentralized	Fully decentralized
DLT network	Fully decentralized	Partly centralized	Fully centralized
DLT privacy	None	Low	High
DLT border	Cross bordered	Cross bordered	Bordered
DLT immutability	Yes	Yes	Yes
DLT persistency	Yes	Yes	Yes
DLT anonymity	High	Low	None

authority or legal structure as the governance approach is developed to involve all participants in the decision-making toward attaining a common goal. Although researchers such as Naudts et al. (2021) stated that there are some forms of centralization, this is because there are software experts who update and maintain the DLT software code (Naudts et al. 2021).

Practically, public-governed DLTs such as Bitcoin, Ethereum, and so on, are open to everybody; anybody can begin a node within the distributed ledger network and participate to settle transactions. However, notwithstanding the inbuilt decentralized nature of public-based DLT, there are factions of node users who scheme in establishing mining developers and networks, which action results to risk the decentralized nature of the DLT network (Anthony Jnr 2021c). Technically, the governance mechanism employed in

public-based DLT platforms is very much reliant on cryptography and the type of consensus algorithm deployed within the DLT software (Naudts et al. 2021). The permissionless ledgers community of participants may include stakeholders or actors such as end users, node operators, software developers, service providers/miners, experts, and ideologists. These stakeholders are clustered in to four main groups (the core developers, the full nodes, the foundation, and the community) as seen in Fig. 11.

Figure 11 depicts the typically clustered stakeholders into four main groups. Each of which is discussed below.

- The *core developers* are software programmers that manage the distributed ledger platform repository. They employ a procedure to update different versions of the DLT source code. In governance structure of DLT plat-

| The core developers | The full nodes | The foundation | The community |
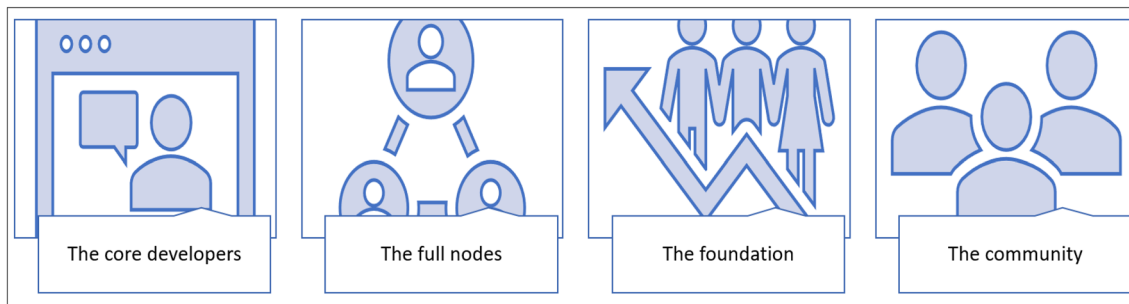
Fig. 11 Clustered stakeholders in permissionless distributed ledgers

form, the core developers are like the legislative branch of government since they can add new code as functionalities (van Pelt 2019); however, they do not have the authority to enforce other node users to use new functionalities added within the DLT platform.

- The *full nodes* are miners who install and run the updated and new versions of the DLT software. They deploy the new updated software source code in their machine for execution to take effect. In comparison with the judicial branch of government, this group of actors can choose to decline a new update or policy as regards to the DLT platform if they disagree with the new functionalities proposed by the core developers (van Pelt 2019).
- The *foundation* is another stakeholder within the distributed ledger network that are mostly non-profit organizations or associations that manages financial assets and funds core developers. The foundation is equivalent with the executive branch as they have explicit jurisdiction over the recruitment of core developers.
- The *community* (end users, enterprises, experts, and ideologists) of a distributed ledger network can be considered as the community, a fourth division that can influence the governance of DLT platform (van Pelt 2019).

Following this distinction, blockchain governance is a balance between a blockchain its core developers, full nodes, foundation (van Pelt 2019), and community. However, these stakeholders represented in Fig. 11 are currently changing. Each stakeholder responsibilities and roles should be considered in initiating a governance approach for DLT adoption in organizations whether in a permissioned or permissionless DLT (Franks 2020).

Furthermore, private-governed DLTs are permissioned and trusted such that all members are known and slightly trusted, consensus or voting is required to validate transactions to be included to the DLT, and read permission is usually restricted or at times public. Likely inclusion to participate in private DLTs is controlled by a single conglomerate such as organizations which adopt DLT to process internal

applications such as data management, business auditing, supply chain management, risk management, and so on. (Yermack 2017). A private DLT is mostly adopted by organizations as it is mostly segmented based on ownership by a single conglomerate or a consortium.

Private or permissioned distributed ledgers have gained attention from industries over the years. This type of distributed ledger constricts transparency by revealing the identity of participants within the distrusted ledger network as access to data or transactions is restricted to a group of certain participants, known to each other. In this distributed ledger, transactions are subjected to endorsement from other participants of the distributed ledger network (Deshpande et al. 2017). In a private DLT, majority of the members are involved in the decision-making toward the operation and development of the DLT platform. The private DLT can be suitable for smaller groups of partners where the governance is properly decentralized to involve all members (Naudts et al. 2021). No proof-of-work consensus mechanism is required to confirm transactions, unlike in permissionless ledger, and consequently, there is no system for incentivization to node users.

4.6.1 Factors that impact the governance of DLT in organizations

The governance of distributed ledger technology adoption in organizations is a decentralized method both in terms of how suggestions for change are rendered and in respect to node users' autonomy to reject or accept policy changes (Lee et al. 2020). The governance issues that impact distributed ledger systems in organizations are structured into economic, technological, political, and social factors as discussed below.

4.7 Economic

4.7.1 Allocation of incentives

Weill and Ross (2004) noted that the allocation of incentives to participants involved in the governance process is important to encourage behavior change toward the overall efficiency of the DLT system. Within the DLT systems, this is associated with the challenges of allocating incentives among miner or different stakeholders (Benedict 2019).

4.7.2 Cost incurred

The distributed nature of DLT results to the high energy costs required in running DLT system and guaranteeing that efficient cost-estimation methods are deployed mainly on the server side to control the demand of resources that may pose a considerable challenge (Deshpande et al. 2017). One of the issues faced by public DLTs is the electricity cost incurred by computer hardware in deploying PoW needed to update the distributed ledger (Yermack 2017).

Based on these arguments, the following proposition is made:

P1. The economic factors will positively inhibit the governance of DLT in organizations.

4.8 Technological

4.8.1 Interoperability and scalability

The governance decisions in distributed ledger systems are increasingly reliant on technical legislation to improve the scalability of decisions across the decentralized partners (Rikken et al. 2019). Thus, there is need for more technically robust DLT systems for scalable governance (Benedict 2019). The adoption of standards would foster organizational partners confidence by specifying how integration and interoperability can be achieved among different DLT-based platforms (current and legacy systems) (Anthony Jnr 2021b).

4.8.2 Compatibility of smart contracts

DLTs employ smart contracts which are self-administering code that is autonomously executed to validate business operation among partners. Smart contracts equally give raise to governance issues as it is not interoperable with existing regulatory and legal frameworks in its operation (Benedict 2019). Besides, there is need for current business regulators to become familiar with how smart contracts operate to effectively support business operations (McLean and Deane-Johns 2016).

4.8.3 Implemented consensus algorithms

The consensus algorithms implemented help to ensure immutability and promote trustworthiness within the distributed ledger systems. Several DLTs implement different consensus algorithms, for example, the PoW consensus algorithm deployed in Ethereum is different from the PoW employed in Bitcoin. This creates a limitation for integrating different DLT systems (Naudts et al. 2021).

Based on the proceeding discussion, the following proposition is made:

P2. The technological factors will positively inhibit the governance of DLT in organizations.

4.9 Political

4.9.1 GDPR's compliance failure

The general data protection regulation (GDPR) was initiated on May 25 2018, to give European Union (EU) citizens more control over their personal data. GDPR supports more of a centralized data controller to help manage participants' data conflicts with the DLT's decentralized data management approach (Trump et al. 2018b), where data are not sole managed by any entity but is governed based on pre-defined consensus rules. Evidently, public DLTs do not adherence to the principles of GDPR, as anybody can join the DLT network as a node user and execute transactions. Public DLT offers no geographical border within its network. Compliance with GDPR's regional scope is more achievable in a private permissioned DLT (Dutta et al. 2020). Besides, the immutability of user's data stored on the distributed ledger means that the data cannot be updated, making it complicated to change. This contradicts the distributed ledger systems on users' right to data erasure, also referred to as the right to be forgotten (Seyedsayamdost and Vanderwal 2020). There is a general discussion of GDPR and DLT. As GDPR addresses, the confidentiality of data and DLTs do not inherently include data confidentiality. This is seen as an issue that has not yet been addressed.

4.9.2 Undistributed control structures

The decentralized nature of DLT systems can result to the rise of a techno-elite systems that lack a formalized authority. In this case, in DLT platforms such as Bitcoin (De Filippi 2019), the governance power is centralized among a minority of stakeholders such as the core developers and a few miners. Ironically, Nakamoto's indicated intent of excluding mediators has over the years has resulted in the investiture of power in other arguably unaccountable entities. As in Bitcoin, governance decisions are consolidated by core developers and mining entities who determine what code changes

to accept into the Bitcoin platform, and miners who choose which protocols to use (Benedict 2019).

4.9.3 Absence of main control

Distributed ledger systems disrupt the traditional approach of centralized governance in digital platforms. As intermediaries and central authorities are excluded in the governance. A main control points which is trusted may be needed to regulate and promote accountability and standardization (Benedict 2019). But, with no authority to regulate participants, the efficiency of the system is faced with possible operational and managerial risks (Meijer and Ubacht 2018). As stated by Calleja López et al. (2017), there are also risks that prevailing powerful political or economic actors take control of distributed ledger systems by capturing 51 percent of the computing power. While the absent of a centralized governance structure in DLTs allows for evolution, adaptation, and flexibility of the governance structure in assimilating of new participants is not well managed since there is no main authority. The main stakeholders are anxious of losing control and direction while investing time/resources to the development of the DLT network (Calleja López et al. 2017).

Based on the above, the following proposition is stated:

P3. The political factors will positively inhibit the governance of DLT in organizations.

4.10 Social

4.10.1 Specifying decision rights

In governance of distributed ledger systems, decision rights are important as they determine the consensus rules that control the DLT platform and performance of key functionalities including member voting, conflict resolution, and forking which occurs in blockchains. But if uncertainty exists as regards to how decisions are made, the complete confidence of members in the use of the DLT platform will be influenced. Therefore, uncertainty in decision-making structure may result to risks which impede the adoption of DLT platforms by participants (Benedict 2019).

4.10.2 Openness issue

Public-based DLTs such as Bitcoin and Ethereum are essentially open source, and all enterprise and individuals interested in contributing to the development process are able to gain access to the distributed ledger networks by installing a digital wallet and purchase tokens from public exchanges (or via other medium) (Zachariadis et al. 2019). The decentralization governance of DLT-based platforms adopted by organizations might leave it exposed to interference. Some

participants may be intent on harming the distributed ledger network or diverting assets among themselves or alternatively might persuade others to employ schemes to exploit the system. But for the permission-based DLTs, updates are authorized by recognized members which enforce security (Yermack 2017).

Based on the aforementioned discussion, the following proposition is stated:

P4. The social factors will positively inhibit the governance DLT in organizations.

Based on the governance issues identified economic, technological, political, and social factors, a governance model is developed as seen in Fig. 12 that influence DLT governance in organizations.

4.11 Discussion

Due to the potentials of distributed ledger technology to transform several sectors, an increasing number of organizations are considering how this emerging technology could be employed in their business. Accordingly, organizations are adopting emerging technologies such distributed ledger systems. Findings from the literature suggest that the adoption of DLT within enterprises are increasing, but issues related to the governance of DLT are becoming more pressing (Deshpande et al. 2017). The governance of DLT platforms is understood to be fully programmed and based on the source code only (Naudts et al. 2021). Zachariadis et al (2019) stated that autonomous blockchain platforms such as Ethereum are also controlled on a distributed basis which led to governance issue due to the lack of a dominant legal entity with official accountability over the DLT system.

But there are fewer studies that examine the governance of distributed ledger technologies adoption in organizations. Therefore, this current study carries out an extensive literature review to investigate the governance of distributed ledger technologies adoption in organizations context by presenting the start-of-the-art governance practices to understand key governance issues in organizations. Additionally, this study identifies factors associated with governance of distributed ledger technologies and a governance model is developed to improve the adoption of distributed ledger technologies adoption to support the digitalization of organizations operations. Findings from this study discuss the current state of DLT adoption in organizations, background of governance in organizations, and current practice of DLT governance in organizations.

The findings also present consensus mechanisms of DLT that are typically employed in organizations and governance typology employed for DLT adoption in organizations. The study provides evidence to practitioners and researchers to better understand the factors that influence the governance of distributed ledger technologies adoption in organizations.

Fig. 12 Developed DLT governance model in organizations
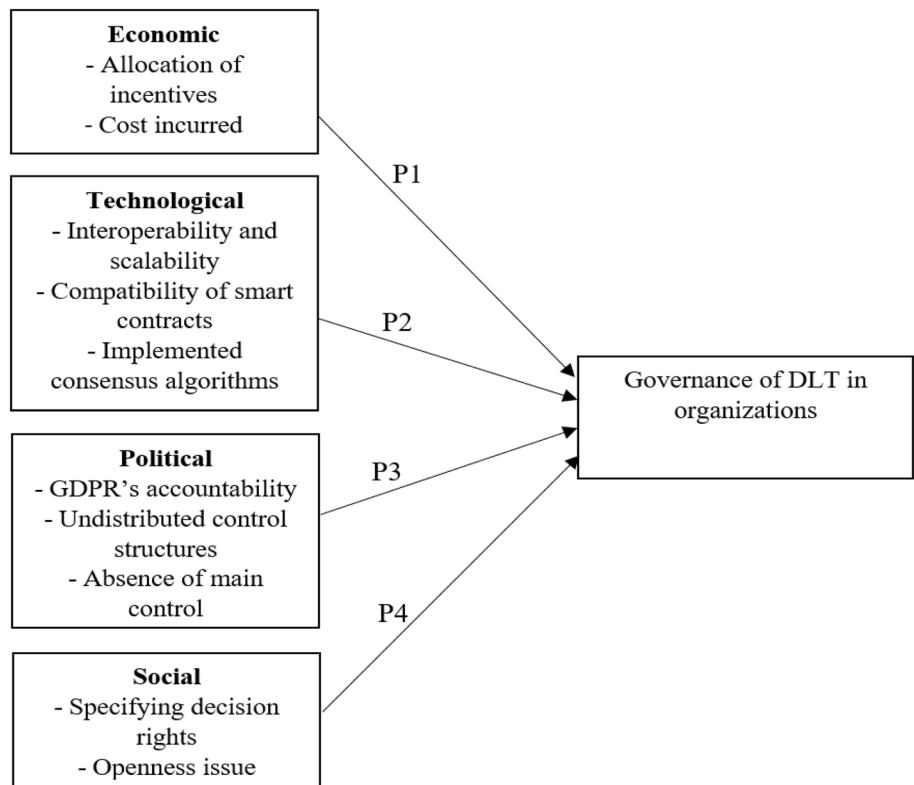
Findings from this article reveals that public and permissionless DLTs are more challenging to manage from a governance perspective, due to their horizontal decentralized nature as compared to traditional centralized governance deployed in organizations. According to Zavolokina et al. (2020), a permission-based DLT is suitable for enterprise that wants to achieve a shared common data source. The permission-based DLT is also suitable for multiple partners involved when there is a need to achieve consensus within an organization or organizations.

5 Recommendations and implications

5.1 Recommendations

Evident from the literature suggests that DLT holds the possibility and provides opportunities across several sectors such as organizations. But research in the governance of distributed ledger systems adoption is still in its early stage and is faced with significant challenges as seen in Fig. 12. (Deshpande et al. 2017). Ultimately, the adoption of distributed ledger systems must be based on a governance approach in which stakeholders or actors agree upon a set of rules to administer the underlying DLT software code (Yermack 2017). A possible solution when organizations adopt a public DLT is the mitigating actions to ensure that the reliability is assured to guarantee that the business continuity of the enterprise is ensured (Naudts et al. 2021).

The use of standards can help provide certainty to all stakeholders or actors who are involved in making decisions within the distributed ledger system. Also, a private DLT can be regulated by a central gatekeeper authority who tries to reduce possible operational risk (Yermack 2017). Standards can be employed to contribute to the alignment of incentives to all stakeholders to help in identifying, classifying, and allocating incentives to all relevant stakeholders. Standards that promote integration and interoperability of different DLT systems to support informed decisions within enterprise process should be employed. Therefore, standards have an important role to support the governance DLT-based platforms to scale beyond the restrictions of traditional, institutionally orientated governance (Benedict 2019).

5.2 Theoretical and practical implications

Over the years, the deployment of DLT in enterprises has evolved and moved beyond cryptocurrency such as Bitcoin. Therefore, policymakers, researchers, and practitioners have started to investigate not just the technological aspect but also the legal, institutional, socio, and economical aspect of governance decisions in distributed ledger systems. However, the concept of governance in DLT has rarely been researched (Nicolae-Bogdan-Cristian et al. 2020). Therefore,

this study develops an approach that provides focal insights about distributed ledger systems forming a reference point for academics and practitioners on the institutionalization of DLTs. Therefore, this study presents a concise discussion of the understanding of governance of DLT thus providing insights into how organizations can improve the governance of DLT. Theoretically, this study presents the dimensions for governance of DLT in organizations which comprises of decision rights of partners, accountability of partners, incentives allocated to partners, and consensus mechanism for partners (as seen in Fig. 9) to provide organizations interested in improving the governance structure of their enterprise process.

Practically, this study presents a governance model as seen in Fig. 12 to depict the governance issues which comprise of economic, technological, political, and social factors that impacts DLT governance in organizations. The purpose of the governance model aims to structure DLTs adoption toward creating a secure, adaptable, efficient, reliable, and sustainable organizations collaboration. Findings from this study discuss the difference between private, public, permissioned, and permissionless DLTs which can be adopted in organizations as seen in Fig. 10. The findings also present the clustered stakeholders (the core developers, the full nodes the foundation, and the community) involved in permissionless distributed ledgers. This article provides a clear overview of governance of distributed ledger systems adoption in organizations to aid in the managing of liabilities, responsibilities, and powers, with regard to its participants involved in organizations.

6 Conclusion

The adoption of emerging technologies such as DLT has changed the way organizations carryout business. DLT presents numerous opportunities to organizations. But the adoption of distributed ledgers is faced with issues related to governance decisions in distributed ledger systems in organizations. Therefore, this study employs secondary data to investigate the start-of-the-art governance practices to offer a comprehensive understanding on key governance issues in organizations. Additionally, findings from this study present factors associated with governance of distributed ledger and decentralized technologies adoption. More importantly, a governance model is developed to enhance the governance of distributed ledger and decentralized technologies adoption to accelerate the digitalization of organizations operations. The model suggested propositions grounded on the economic, technological, political, and social factors that influence the governance of DLT in organizations. From the theoretical discussion, this study develops a model

for examining the factors that influence the governance of DLT based on economic, technological, political, and social factors.

The paper also highlights the recommendations for the various topologies of DLTs and stakeholders involved in the governance decisions in distributed ledger systems. In summary, this study improves the lack of understanding on the governance of distributed ledger and decentralized technologies adoption in organizations. This study has a few limitations which have opened interesting areas for future research. First, there is need to conduct empirical data to validate the developed model. Primary data can be collected via interviews or surveys. Findings from the primary data can be used to confirm the applicability of governance model in distributed ledger systems. Lastly, more research is to be carried out regarding factors that influence the governance of DLTs in organizations.

Declarations

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