Corporate Governance in the Digital Age: A Comprehensive Review of Blockchain, AI, and Big Data Impacts, Opportunities, and Challenges

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Abstract. This research examines the intersection of disruptive technologies specifically blockchain, AI, and Big Data with corporate governance, synthesizing insights from a diverse range of scholarly works. This research employed a comprehensive literature review methodology. We sourced and analyzed scholarly articles and papers from prominent databases, focusing on key themes such as the impact of these technologies on corporate governance, potential benefits, and associated challenges. We investigate the implications of these technologies on corporate governance, scrutinizing potential benefits and associated challenges. Our findings reveal that blockchain, with its potential to enhance transparency and reduce information asymmetry, promises to transform accounting and auditing practices. Nevertheless, the successful integration of blockchain into mainstream financial systems necessitates addressing technical and regulatory challenges. AI's potential to augment decision-making capabilities offers opportunities for improved auditing efficiency, yet raises ethical concerns and implementation complexities. Lastly, Big Data presents opportunities for driving sustainable innovation and informed decision-making, while posing significant challenges concerning data privacy and security. This study's findings carry implications for practitioners, policymakers, and academics alike, providing critical insights into the dynamic interplay between disruptive technologies and corporate governance. Future research may extend this work through empirical studies and comparative analyses across industries and regions.

Keywords: Corporate Governance, Blockchain, AI, Big Data

1 Introduction

In Corporate governance, the fundamental system through which corporations are directed and controlled, has always been a dynamic field shaped by various internal and external influences [1,2]. As we have transitioned into a technology-dominated era, the nature of
corporate governance has undergone considerable transformation, warranting a detailed examination [1,3]. Since its inception, corporate governance has been regarded as both an art and a science [4]. Its frameworks have been primarily based on theoretical constructs, legal requirements, and the cumulative wisdom of practitioners. However, as the wave of disruptive technologies and innovations (DTIs) sweeps across industries, the landscape of corporate governance is changing dramatically [5,6]. This evolution necessitates an exploration of corporate governance as an emerging science in the context of the technology age [7].

In the last few decades, we have witnessed an exponential growth in technological advancements, with disruptive technologies like artificial intelligence, blockchain, big data, and the Internet of Things redefining the business ecosystem. These technologies have not only transformed business operations and strategies but also instigated a shift in corporate governance structures and principles [5]. Consequently, the understanding and practice of corporate governance have evolved from a traditional management-centric approach to a more complex, technology-embedded discipline.

This paper aims to delve into the profound implications of disruptive technologies on the science of corporate governance. We will explore the changes in business models, risk management, transparency and reporting, stakeholder engagement, and regulatory compliance brought about by these technological breakthroughs. Furthermore, we will analyze how the field of corporate governance is innovating and adapting to these technological disruptions, thus charting a new course for its development as a scientific discipline in the technology age.

The broader objective of this research is to shed light on the emerging trends and challenges in corporate governance in the wake of technological disruptions, thereby enabling corporations, regulators, researchers, and practitioners to design more sustainable, inclusive, and resilient governance systems. This investigation will contribute to the burgeoning body of knowledge surrounding corporate governance and technology, providing a foundation for future research and policy-making in this critical field.

2 Thematic Analysis

2.1 New Paradigm in Corporate Governance

Blockchain and AI are emerging as powerful technological tools that are redefining the landscape of corporate governance, particularly in the realms of accounting and auditing [8]. Blockchain technology, with its decentralized and immutable ledger system, introduces unprecedented levels of transparency, security, and efficiency to accounting processes [9]. It allows for real-time accounting, enabling instant updates of financial records as transactions occur. This shift marks a move towards an event-based approach to accounting and a departure from traditional, batch-based accounting systems. Moreover, the advent of triple-entry accounting, facilitated by blockchain, enhances the verification and validation of transactions, thus minimizing potential accounting discrepancies [10]. On the other hand, artificial intelligence (AI) plays a pivotal role in auditing [8]. Integrated with blockchain, AI can learn from the immutable and consensus-driven data, recognizing patterns that can significantly improve decision-making processes in auditing. The concept of continuous auditing, where financial records are reviewed on a rolling basis, is propelled to new heights with AI's ability to swiftly analyze large volumes of data. Additionally, the application of smart contracts on blockchain platforms can automate certain accounting and auditing processes, reducing potential for managerial manipulation and opportunistic behavior. The
combined use of blockchain and AI in accounting and auditing exemplifies the transformative potential of these technologies, setting the stage for a new paradigm in corporate governance [8].

2.2 New Trajectory in Corporate Governance

The transformative potential of blockchain technology (BT) has caught the attention of both scholars and practitioners [10–12], particularly its implications for accounting, auditing, and finance. Blockchain's attributes of decentralization, transparency, and immutability introduce a novel approach to these areas, shaking the very foundations of traditional corporate governance. An analysis of academic literature published from 2015 to 2021 reveals a growing recognition of this potential, albeit an acknowledgment that the innovation and ensuing disruption of BT is still in its nascent phase, particularly in accounting, auditing, and finance practices [6]. The literature elucidates several themes, indicating how blockchain is reshaping these traditional functions [1]. In accounting, blockchain's capacity for maintaining real-time, immutable records simplifies financial management and reduces errors and fraud. In auditing, the integration of blockchain technology promises improved efficiency, accuracy, and transparency, promoting a continuous auditing approach. Meanwhile, in finance, blockchain offers opportunities for frictionless transactions, enhanced security, and better regulatory compliance [13]. While these shifts indicate the transformative potential of blockchain, it's clear that the scope and influence of this technology in accounting, auditing, and finance is still evolving [6,8]. This ongoing evolution presents numerous avenues for future research, which can contribute to both theoretical development and practical implementation, ultimately aligning theory with practice in the realm of corporate governance.

2.3 Leap Forward in Corporate Governance

The integration of Big Data and sustainability innovation has paved the way for a transformative shift in corporate governance [14]. As the bedrock of modern information and communication technology advancements, Big Data offers valuable insights that can drive sustainable innovation [15], particularly in the realm of corporate governance. An analysis of academic literature published in the last decade, especially since 2014, reveals a growing emphasis on this convergence from various fields including environmental sciences, science technology, business economics, engineering, and computer sciences [14]. Big Data, with its ability to process vast amounts of complex information, can facilitate informed decision-making and strategic planning, crucial to the success of sustainable innovation [14,16]. This capability is increasingly being harnessed in corporate governance to drive efficiency, transparency, and accountability, leading to improved environmental, social, and economic outcomes. Furthermore, the co-occurrence analysis identifies six keyword clusters, illuminating the multifaceted ways Big Data intersects with sustainability. From improving operational efficiencies and reducing waste, to creating new sustainable business models and fostering stakeholder engagement, Big Data plays a vital role [17]. However, the full potential of Big Data in driving sustainability innovation is yet to be fully realized. This presents a wealth of opportunities for future research and practical application in the realm of corporate governance, potentially shaping more sustainable business practices and societal outcomes in the process. As we move forward, the synergy of Big Data and sustainability innovation is set to redefine corporate governance, creating a more accountable, transparent, and sustainable business environment [14].
2.4 Novel Evaluation Approach

The era of digital transformation has ushered in revolutionary technologies such as blockchain, impacting diverse industries, including construction. While these technologies harbor immense potential, they also introduce unique risks that require careful management [18]. An in-depth understanding of these risks, from a firm-level perspective, is necessary to formulate proactive strategies, thereby reinforcing the role of corporate governance in ensuring business objectives are not overshadowed by these disruptive forces [18,19]. To better understand and manage these risks, the research outlined herein proposes a novel model for risk assessment based on the trapezoidal fuzzy ordinal priority approach (OPA-F) [18]. This model, particularly useful in the context of multi-criteria decision-making, accommodates the uncertainties of expert judgement across three primary parameters: the importance of organizational criteria, the impact of blockchain risks on said criteria, and the probability of risk occurrence. The research's findings indicate that the domain of "communication and information" within an organization is most susceptible to blockchain risks, while "corporate social responsibility" remains largely unaffected. Effective blockchain risk management, as indicated by the case study, can lead to cost efficiency, improved quality, and enhanced customer experience. These findings underscore the significance of corporate governance in navigating the technological disruption caused by blockchain, reinforcing the need for an integrated, risk-focused approach to its implementation [1,5,18].

3 Research Design

In Given the exploratory nature of this study, we will employ a qualitative research methodology [20]. Our primary method of data collection will be an extensive review of existing literature. The resources will be identified through systematic searches in academic databases like Scopus, Web of Science, and Google Scholar.
and conference proceedings published until 2023. The inclusion criteria will be papers that primarily focus on the intersection of corporate governance and disruptive technologies.

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Year</th>
<th>Study Title</th>
<th>Main Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brennan</td>
<td>2019</td>
<td>Corporate governance implications of disruptive technology: An overview</td>
<td>Disruptive Technology, Corporate Governance, Accounting Mechanisms</td>
</tr>
<tr>
<td>Akhtar</td>
<td>2023</td>
<td>Blockchain Technology: the Beginning of a New Era in Reforming Corporate Governance Mechanisms</td>
<td>Blockchain, Corporate Governance, Agency Costs</td>
</tr>
<tr>
<td>Singh</td>
<td>2023</td>
<td>How Blockchain Is Transforming Accounting, Auditing and Finance: A Systematic Review</td>
<td>Blockchain, Accounting, Auditing, Finance</td>
</tr>
<tr>
<td>Harsanto</td>
<td>2022</td>
<td>Big Data and Sustainability Innovation</td>
<td>Big Data, Sustainability Innovation</td>
</tr>
<tr>
<td>Sadeghi</td>
<td>2022</td>
<td>Blockchain technology in construction organizations: risk assessment using trapezoidal fuzzy ordinal priority approach</td>
<td>Blockchain, Risk Assessment, Construction Organizations</td>
</tr>
</tbody>
</table>

In this Table 1, we present the primary sources that form the basis of our research design. The table outlines each source's authors, the year of publication, the title of the study, and the main themes of each study.

1. Brennan (2019) explores the implications of disruptive technology on corporate governance, with a specific focus on the effect on accounting mechanisms. This study serves as a conceptual basis for understanding the broad changes that
disruptive technologies like blockchain, AI, and big data can bring to corporate governance and the role of accounting in this context.

2. Akhtar (2023) focuses on the potential of blockchain technology to reform corporate governance mechanisms. This source is particularly useful for understanding how blockchain technology can enhance transparency and accountability, reducing agency costs, which is a primary concern in corporate governance.

3. Singh (2023) provides a systematic review of how blockchain is transforming accounting, auditing, and finance. This source gives detailed insights into the operational changes that blockchain can bring about in these specific areas and contributes to a deeper understanding of blockchain's practical applications.

4. Harsanto (2022) discusses the role of big data in driving sustainability innovation. This study is crucial for understanding how big data, another disruptive technology, can contribute to corporate sustainability, which is increasingly becoming a critical aspect of corporate governance.

5. Sadeghi, et al. (2022) conduct a risk assessment of implementing blockchain technology in construction organizations using a novel approach. Although specific to the construction industry, this study's methodology and findings contribute to the broader understanding of the risks and challenges associated with implementing blockchain technology.

Each of these studies contributes different perspectives and insights, enriching our research design by providing a multifaceted understanding of the impact of disruptive technologies on corporate governance. For data analysis, we will adopt a thematic analysis approach, which will allow us to distil and categorize the primary themes emerging from the selected studies. This process will involve initial coding, theme development, and finalization of themes. This study is limited by the inherent constraints of a literature review, including potential publication bias and limited access to all published literature on the subject. Despite these limitations, this study aims to provide a comprehensive overview of the current understanding of how disruptive technologies are shaping corporate governance.

4 Discussion

Our study highlights the transformational impact of disruptive technologies like blockchain, AI, and big data on corporate governance mechanisms. These technologies have the potential to reshape traditional corporate governance practices by enhancing transparency, reducing information asymmetry, and mitigating managerial opportunism.
In the domain of accounting and auditing, blockchain technology, complemented by AI, presents opportunities for real-time accounting, event-based accounting, continuous auditing, and the use of smart contracts. Smart contracts, being self-executing with terms directly written into code, can help prevent managerial manipulation and reduce unethical behaviors. In terms of risk management, blockchain technology introduces both opportunities and challenges. It can enhance communication and information accuracy within organizations but also poses risks that need to be addressed with proactive strategies.
Big data, on the other hand, has been recognized for its role in fostering sustainable innovation in business and society. The insights derived from big data analysis can aid in making informed decisions and strategies aimed at long-term sustainability. Despite the promising potential of these disruptive technologies, it is crucial to understand that they are not a panacea. They come with their own set of challenges, including technical, organizational, and regulatory hurdles, which need to be carefully managed for their successful implementation.

### Table 2. Synthesized Findings

<table>
<thead>
<tr>
<th>Disruptive Technology</th>
<th>Impact on Corporate Governance</th>
<th>Potential Benefits</th>
<th>Potential Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blockchain</td>
<td>Enhances transparency and reduces information asymmetry</td>
<td>Real-time accounting, Continuous auditing, Use of smart contracts</td>
<td>Technical and regulatory challenges, potential risks to business objectives</td>
</tr>
<tr>
<td>AI</td>
<td>Augments decision-making capabilities, particularly in auditing</td>
<td>Enhanced efficiency in audits, pattern recognition for improved decision-making</td>
<td>Complexity in implementation, possible ethical concerns</td>
</tr>
<tr>
<td>Big Data</td>
<td>Enables sustainable innovation</td>
<td>Informed decision-making for sustainability, improved stakeholder collaboration</td>
<td>Data privacy and security issues, need for skilled workforce</td>
</tr>
</tbody>
</table>

#### 4.1 Blockchain

Blockchain technology transforms corporate governance by enhancing transparency and reducing information asymmetry [5,13]. This disruption allows stakeholders to have greater access to information, which leads to more informed decision-making. Blockchain has the potential to bring about real-time accounting, continuous auditing, and the use of smart contracts. Real-time accounting allows for instantaneous recording and tracking of
transactions, reducing errors and fraud. Continuous auditing means auditors can review accounts and processes in real-time, enhancing audit efficiency and accuracy. Smart contracts automate processes and can reduce managerial manipulation and opportunistic behaviour [8]. However, implementing blockchain technology is not without its challenges. The technology is still in its development stage, and many technical and regulatory challenges need to be overcome. Additionally, there can be potential risks to business objectives as the adoption of this disruptive technology can lead to fundamental shifts in business models.

4.2 Artificial Intelligence (AI)

AI has the potential to significantly augment decision-making capabilities, particularly in auditing [6,8]. The incorporation of AI can lead to more effective and efficient audits, which can further enhance corporate governance. AI's ability to learn from data to recognize and apply patterns can enhance efficiency in audits and improve decision-making. This can lead to more robust corporate governance mechanisms and potentially higher firm performance. The implementation of AI, however, is complex and may lead to ethical concerns, such as data privacy and job displacement [21]. It also requires significant investments in technology and skilled personnel.

4.3 Big Data

Big Data, with its ability to analyze vast amounts of information quickly, can enable sustainable innovation in corporate governance [5,14]. Big Data can help inform decision-making for sustainability, improving stakeholder collaboration, and enhancing the overall governance of corporations. The use of Big Data can potentially lead to more sustainable and socially responsible business practices. On the other hand, the use of Big Data comes with its own set of challenges, such as data privacy and security issues [9]. There's also a need for a skilled workforce that can interpret and make sense of the vast amounts of data. Furthermore, the infrastructure required to handle Big Data can be costly, posing a challenge for smaller firms.

5 Conclusion

This research synthesized various perspectives on the intersection of disruptive technologies, specifically blockchain, AI, and Big Data, with corporate governance. Each technology was found to have profound implications for how businesses are governed, bringing with them potential benefits but also considerable challenges. Blockchain's ability to enhance transparency and reduce information asymmetry promises to revolutionize accounting and auditing practices. However, it is imperative to address associated technical and regulatory challenges for its integration into mainstream financial systems. AI, by augmenting decision-making capabilities, offers possibilities of efficiency and accuracy in auditing, yet ethical concerns and the complexity of implementation must be considered. Lastly, Big Data has the potential to drive sustainable innovation, contributing to improved decision-making and stakeholder collaboration, but it also raises serious issues around data privacy and security. While this research provides insights into the potential of blockchain, AI, and Big Data in transforming corporate governance, several avenues remain for future research. For instance, empirical studies could be conducted to measure the real-world impact of these technologies on corporate governance. Comparative studies across different industries and geographical regions may also prove insightful. One of the limitations of this study is its reliance on existing literature, which inherently reflects the biases and limitations
of the original studies. Future research might seek to incorporate primary data to gain a more nuanced understanding of the intersection between technology and corporate governance. The findings have implications for practitioners, policy-makers, and academics alike. Businesses need to comprehend the potential benefits and challenges of disruptive technologies to make informed decisions about adoption and implementation. Policy-makers must consider the broader societal and regulatory implications, developing frameworks that promote the ethical and responsible use of these technologies. Academics can contribute by continuing to refine theories around technology's role in corporate governance, offering critical insights that can shape policy and practice.

REFERENCES