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THE UNSUSTAINABLE MODEL OF MODERN ACADEMIC PUBLISHING: THE '*PUBLISH OR PERISH*' CULTURE

The "publish or perish" ethos, pervasive in academic institutions, drives researchers to prioritize publication metrics over the intrinsic value and rigor of their work. While the system ensures sustained research output and global visibility, it has significant drawbacks that undermine the quality of academic publications:

Quality versus Quantity: The "publish or perish" culture incentivizes the volume of publications, often at the expense of their quality. Scholars are compelled to fragment their findings into multiple smaller studies ("salami slicing") to increase publication counts, resulting in incremental rather than groundbreaking contributions. This trend dilutes the overall impact of research and overcrowds journals with low-citation papers, many of which fail to advance their fields meaningfully.

Rise in Unethical Practices: The pressure to maintain a high publication rate fosters unethical behaviors such as data falsification, plagiarism, and duplicate publications. Instances of fraudulent research, as noted in the articles, not only tarnish the reputation of the scientific community but also mislead subsequent research, wasting resources and eroding public trust in science. Moreover, the proliferation of predatory journals provides an outlet for substandard or unethical research, further weakening the integrity of academic literature.

Impact on Peer Review and Journal Quality: The exponential growth in publications overwhelms the peer-review system, leading to superficial reviews and compromised journal standards. Journals may prioritize sensational or commercially viable research over robust and reproducible studies, skewing the academic reward system. This commercialization risks sidelining research with long-term value but limited immediate appeal.

Erosion of Research Integrity: The focus on publishing in high-impact journals often promotes strategic shortcuts, such as neglecting negative results or avoiding experiments that might refute hypotheses. This selective reporting hampers the reproducibility of findings, contributing to a growing "reproducibility crisis" in fields like biomedicine and social sciences.

Psychological and Institutional Impacts: The relentless demand to publish exacts a heavy toll on academics' mental health, fostering stress, burnout, and a reduced focus on teaching responsibilities. Institutions' reliance on publication metrics for recruitment and promotion detracts from holistic academic excellence, sidelining scholars whose primary contributions lie in mentorship, pedagogy, or public engagement.

Global and Regional Disparities: While "publish or perish" encourages global participation, it exacerbates inequalities, particularly for scholars in developing regions with limited access to resources. These disparities compel some researchers to turn to predatory journals, compromising the credibility of their work.

Recommendations:

The "publish or perish" paradigm has created a competitive but flawed academic ecosystem that prioritizes immediate outputs over sustained innovation and rigor. To mitigate its detrimental effects:

1. **Redefine Evaluation Metrics:** Universities and funding agencies should shift from publication quantity to broader criteria emphasizing societal impact, teaching contributions, and research quality.

2. **Promote Open Science:** Encouraging transparency through data sharing and open-access publications can enhance research reproducibility and public trust.
3. **Strengthen Ethical Oversight:** Institutions and journals should implement stricter measures to deter misconduct, including penalties for fraudulent research and predatory publishing.
4. **Balance Workload:** Academic policies should ensure equitable emphasis on research, teaching, and service to foster a healthier work environment.

Balancing the pressure to publish with a commitment to quality, integrity, and innovation is vital to safeguarding the future of academia.

December 2024

Prof. Dr. Mustafa Zihni TUNCA
Editor-in-Chief

SUSTAINABILITY DISCLOSURES AND THEIR INTEGRATION: INSIGHTS FROM GLOBAL REPORTING INITIATIVE (GRI) STANDARDS

Buğra ÜNLÜ*

Mahmut Sami ÖZTÜRK**

* Corresponding Author, Dr., Isparta University of Applied Sciences, Şarkikaraağaç Vocational School, Business Administration Program, bugraunlu@isparta.edu.tr, <https://orcid.org/0000-0002-6305-4191>.

** Assoc. Prof. Dr., Süleyman Demirel University, Faculty of Economics and Administrative Sciences, Dept. of Business Administration, samiozturk@sdu.edu.tr, <https://orcid.org/0000-0002-7657-3150>.

ABSTRACT

The study examines the interrelationships between economic, environmental, and social disclosures in sustainability reports prepared in accordance with the Global Reporting Initiative (GRI) standards. Using data from 46 companies listed on the Borsa Istanbul (BIST) that published sustainability reports for 2021, the number of disclosures across the three dimensions was analyzed. Pearson correlation and regression analyses were employed to explore relationships between these dimensions and their mutual impacts. The results reveal significant relationships among all three dimensions, with both environmental and social disclosures positively influencing economic disclosures. Companies that prioritized environmental and social aspects in their sustainability reports demonstrated a stronger alignment with economic disclosures, suggesting that a focus on broader sustainability practices can support economic performance. The findings highlight the importance of integrating the three pillars of sustainability for long-term corporate resilience and profitability. Furthermore, the analysis shows that social disclosures were the most frequently reported, followed by environmental and economic disclosures, indicating a potential prioritization of social responsibility initiatives among BIST-listed companies. These results underscore the critical role of comprehensive sustainability reporting in meeting stakeholder expectations and aligning with sustainable development goals. The study contributes to the literature by providing empirical evidence on the integration of economic, environmental, and social dimensions in sustainability reports. It offers practical insights for policymakers, corporate managers, and sustainability practitioners on enhancing reporting practices and improving stakeholder communication. Future research is encouraged to explore these relationships across industries and global contexts.

Keywords: Sustainability Reporting, GRI Standards, Triple Bottom Line, Corporate Responsibility, Economic Performance.

1. INTRODUCTION

Corporate sustainability has evolved into a multidimensional concept encompassing economic, environmental, and social dimensions. Defined as the integration of social and environmental considerations into business operations and stakeholder relations, sustainability extends beyond traditional economic performance metrics (Gedik, 2020). It emphasizes the balanced achievement of financial objectives alongside environmental preservation and social equity, recognizing these as critical components of long-term success (Heemskerck et al., 2002, as cited in Ertan, 2018). This perspective aligns with the *Triple Bottom Line* (TBL) framework proposed by Elkington (1997), which

argues that businesses must evaluate their performance across economic, environmental, and social domains to achieve sustainable development.

The TBL approach highlights the interdependence of these dimensions. While prioritizing economic outcomes may yield short-term success, studies suggest that long-term corporate viability hinges on a balanced focus on all three sustainability pillars (Dyllick & Hockerts, 2002). Proactive environmental strategies, for instance, have been linked to improved financial performance, although this relationship may vary depending on the strategic approach adopted by individual firms (Clarkson et al., 2011). Similarly, a focus on social issues such as labor rights

and community welfare is increasingly viewed as a driver of economic resilience and stakeholder trust.

In recent years, the growing urgency of global challenges such as climate change, resource depletion, and social inequality has reshaped stakeholder expectations. Businesses are under increasing pressure to demonstrate their commitment to sustainability through transparent reporting practices (Canlı & Seçmeli, 2024). Sustainability reports, guided by frameworks such as the Global Reporting Initiative (GRI), have become a vital tool for businesses to communicate their environmental, social, and economic performance to stakeholders (Schaltegger & Wagner, 2006). These reports offer a structured approach to integrating sustainability into corporate strategy, enabling businesses to align with global sustainable development goals (WCED, 1987).

Sustainability reporting has emerged as a cornerstone of corporate accountability, reflecting the growing importance of non-financial disclosures (Ağaç & Öztürk, 2023). Historically, businesses focused primarily on economic reporting, but the inclusion of environmental and social metrics has gained prominence in response to evolving stakeholder demands (Çalışkan, 2012). GRI standards, established as a global benchmark, have played a pivotal role in standardizing sustainability reporting, providing clear guidelines for organizations to report their impacts comprehensively (GRI, 2024).

Research highlights several benefits of sustainability reporting. Çalışkan (2012) emphasized its role in meeting stakeholder expectations and achieving corporate social responsibility (CSR) objectives. Similarly, studies by Hahn & Kühnen (2011) and Gümrah & Büyükepekçi (2019) revealed that sustainability reports enhance transparency, improve stakeholder engagement, and foster organizational accountability. However, despite its advantages, the implementation of sustainability reporting practices varies widely across industries and regions.

In Turkey, for example, sustainability reporting has gained traction among companies listed on the Borsa

Istanbul (BIST) index. Studies such as those by Korga & Aslanoglu (2024) and Ögünç (2021) have documented the adoption of GRI standards by BIST-listed firms, highlighting the variability in the depth and scope of disclosures. While some companies prioritize environmental metrics, others focus more on social dimensions, reflecting diverse strategic priorities and stakeholder pressures.

A key challenge in sustainability reporting lies in achieving integration across economic, environmental, and social dimensions. The literature underscores the interconnections between these domains, suggesting that a holistic approach to reporting can yield synergistic benefits. For instance, environmental initiatives often require substantial financial investments, linking environmental and economic dimensions. At the same time, social initiatives such as employee welfare programs can enhance productivity and economic performance, creating a feedback loop between social and economic dimensions (Schaltegger & Wagner, 2006).

Despite these interconnections, studies suggest that integration remains incomplete in many organizations. Roca & Searcy (2012) found that while sustainability reports often include a wide range of indicators, the emphasis on integration varies significantly. Similarly, Şahin & Cankaya (2018) observed that GRI-based reports often prioritize strategic and profile disclosures over detailed performance metrics, reflecting cost considerations and reporting limitations.

While the literature provides valuable insights into sustainability reporting practices, several gaps remain. Most studies have focused on the historical development of reporting frameworks, the determinants of adoption, or the impact of sustainability initiatives on financial performance. Few have examined the interrelationships between economic, environmental, and social disclosures within sustainability reports. This gap is particularly pronounced in the context of BIST-listed companies, where reporting practices are still evolving.

This study aims to address this gap by analyzing the integration of economic, environmental, and social dimensions in the sustainability reports of BIST-

listed firms. Using data from 46 companies that published GRI-compliant sustainability reports for 2021, the study investigates the relationships between disclosure frequencies across the three dimensions. Specifically, it seeks to answer the following research questions:

1. Is there a significant relationship between economic, environmental, and social disclosures in sustainability reports?
2. Do environmental and social disclosures influence economic disclosures, and if so, to what extent?

By addressing these questions, the study contributes to the literature on sustainability reporting and provides practical insights for businesses seeking to enhance their reporting practices.

The paper is organized as follows:

- **Literature Review:** This section provides an overview of prior studies on sustainability reporting, highlighting key trends and theoretical frameworks.
- **Methodology:** The research design, data collection process, and analytical methods are described in detail.
- **Results:** Findings from the correlation and regression analyses are presented, with a focus on the relationships between disclosure dimensions.
- **Discussion and Conclusion:** The implications of the findings are discussed, along with recommendations for practitioners and policymakers.

By examining the interplay between economic, environmental, and social dimensions in sustainability reporting, this study seeks to advance understanding of integrated reporting practices and their potential to drive corporate sustainability.

2. LITERATURE REVIEW

The study of sustainability reporting has gained significant attention in academic and professional circles, with a focus on understanding the economic, environmental, and social dimensions of corporate

performance. This section reviews existing literature on the historical development of sustainability reporting, the application of GRI standards, and the relationships between economic, environmental, and social disclosures.

Historical Development of Sustainability Reporting

Sustainability reporting has evolved in response to the growing recognition of corporate responsibility toward environmental and social issues. Initially, corporate reporting was predominantly financial, aimed at shareholders and investors. However, increasing awareness of global challenges such as climate change, social inequality, and resource depletion has led to broader reporting frameworks that include non-financial metrics (Çalışkan, 2012).

The Triple Bottom Line (TBL) framework proposed by Elkington (1997) marked a paradigm shift in corporate accountability. This model emphasized the importance of evaluating economic, environmental, and social dimensions collectively, advocating for a balance that supports long-term sustainable development. While the TBL framework provided a theoretical foundation, its practical implementation required standardized guidelines. The introduction of the Global Reporting Initiative (GRI) standards addressed this need, establishing a globally recognized framework for sustainability reporting (GRI, 2024).

Adoption and Impact of GRI Standards

The GRI standards have been instrumental in shaping sustainability reporting practices worldwide. By offering a structured approach to reporting, the standards facilitate transparency and comparability across organizations. Schaltegger & Wagner (2006) highlighted the role of GRI standards in integrating sustainability performance with corporate strategy, enabling businesses to align their operations with stakeholder expectations.

Studies have examined the adoption of GRI standards across various contexts. For instance, Hahn & Kühnen (2011) conducted a comprehensive review of 178 articles published between 1999 and 2011, identifying key determinants of sustainability

reporting. They noted that while environmental performance often drives reporting activities, social performance tends to receive less emphasis. Similarly, Gümrah & Büyükipekçi (2019) analyzed sustainability reports published in Turkey between 2008 and 2017, revealing significant differences in reporting practices between small and medium-sized enterprises (SMEs) and large multinational corporations.

In the context of Turkey, Ögünç (2021) examined the sustainability reports of companies listed on the Borsa Istanbul (BIST) index, finding considerable variability in the number and scope of GRI disclosures across sectors. These findings underscore the role of industry characteristics and organizational capabilities in shaping sustainability reporting practices.

Economic, Environmental, and Social Dimensions in Sustainability Reporting

Sustainability reporting aims to capture the interrelationships between economic, environmental, and social dimensions, reflecting the interconnected nature of corporate activities. The integration of these dimensions is critical for achieving long-term sustainability goals. However, the literature reveals significant disparities in how these dimensions are prioritized and reported.

Economic disclosures typically focus on financial performance, including revenue generation, cost efficiency, and shareholder value creation. Studies suggest that businesses often emphasize economic metrics due to their direct relevance to investors and other financial stakeholders (Purvis, Mao & Robinson, 2019). However, the integration of economic disclosures with environmental and social dimensions remains limited. For instance, Şahin & Cankaya (2018) found that while GRI-compliant reports in Turkey often include strategic and profile-related disclosures, detailed economic performance indicators are less prevalent.

Environmental disclosures address corporate impacts on natural resources, including energy consumption, carbon emissions, and waste management. Clarkson et al. (2011) highlighted the positive relationship between proactive

environmental strategies and financial performance, emphasizing the potential economic benefits of environmental sustainability. However, Roca & Searcy (2012) observed that the emphasis on environmental metrics varies significantly across industries, with resource-intensive sectors such as manufacturing and energy placing greater importance on these disclosures.

Social Disclosures encompass issues related to human rights, labor practices, community engagement, and stakeholder well-being. These disclosures reflect a company's commitment to social equity and ethical practices, aligning with broader societal expectations. Kılıç & Kuzey (2019) examined the relationship between corporate governance and social disclosures, finding that companies with diverse boards and sustainability committees are more likely to prioritize social reporting. Despite their importance, social disclosures often receive less attention compared to economic and environmental metrics, particularly in developing economies (Peker, 2024).

Interrelationships Between Sustainability Dimensions

The interplay between economic, environmental, and social dimensions is a critical area of study in sustainability reporting. Research suggests that these dimensions are interdependent, with synergies and trade-offs influencing corporate performance.

Clarkson et al. (2011) argued that environmental initiatives often require financial investments, linking environmental and economic dimensions. Similarly, social initiatives such as employee welfare programs and community development projects can enhance economic performance by fostering stakeholder trust and loyalty. However, achieving integration across these dimensions remains a challenge for many organizations.

Studies have explored the extent to which sustainability reports reflect these interrelationships. For example, Korga & Aslanoğlu (2024) analyzed GRI-compliant reports from 23 BIST-listed companies, finding that social disclosures often outweigh environmental and economic metrics. This imbalance suggests that while companies recognize

the importance of social responsibility, the integration of environmental and economic considerations into reporting practices requires further development.

Challenges and Opportunities in Sustainability Reporting

Despite the progress in sustainability reporting, several challenges persist. One key issue is the cost of reporting, particularly for SMEs with limited resources. Şahin & Cankaya (2018) noted that the additional cost of detailed economic, environmental, and social disclosures often deters smaller organizations from adopting comprehensive reporting practices.

Another challenge lies in the standardization of metrics. While GRI standards provide a robust framework, the lack of industry-specific guidelines can lead to inconsistencies in reporting. Roca & Searcy (2012) highlighted the wide variation in indicators used across reports, emphasizing the need for greater harmonization.

Nevertheless, sustainability reporting also presents significant opportunities. By adopting integrated reporting practices, organizations can enhance transparency, build stakeholder trust, and align with global sustainable development goals. The growing adoption of frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD) and the International Integrated Reporting Council (IIRC) further underscores the potential for innovation in sustainability reporting.

Research Gaps and Contribution of the Study

While the literature provides valuable insights into sustainability reporting, several gaps remain. Most studies have focused on individual dimensions or specific industries, with limited attention to the interrelationships between economic, environmental, and social disclosures. Furthermore, there is a lack of empirical research on the integration of these dimensions in the context of developing economies, including Turkey.

This study addresses these gaps by analyzing the sustainability reports of 46 BIST-listed companies for 2021. By examining the relationships between

disclosure frequencies across economic, environmental, and social dimensions, the study provides new insights into the integration of sustainability reporting practices. It contributes to the literature by highlighting the importance of balanced reporting and offering practical recommendations for businesses seeking to enhance their sustainability strategies.

3. EMPIRICAL ANALYSIS OF SUSTAINABILITY DISCLOSURES: INSIGHTS FROM BIST-LISTED COMPANIES

This section presents a detailed analysis of the sustainability disclosures published by 46 companies listed on Borsa Istanbul (BIST) in their 2021 reports, prepared in accordance with Global Reporting Initiative (GRI) standards. The methodology employed in this study involved collecting and categorizing disclosures from publicly available sustainability reports, focusing on three core dimensions: economic, environmental, and social. Each disclosure was quantified to enable statistical analysis, ensuring consistency and comparability across companies. To maintain confidentiality, the companies were anonymized and assigned numerical identifiers.

The research utilized Pearson Correlation and regression analyses to explore the relationships between the dimensions and assess their potential impacts on one another. These methods were chosen for their ability to identify both the strength and significance of interrelationships, providing empirical insights into the integration of sustainability dimensions. This approach not only facilitates a robust understanding of reporting practices but also addresses gaps in the literature by offering quantitative evidence on how these disclosures influence each other. The subsequent tables and discussions aim to highlight trends, disparities, and implications for sustainability reporting, shedding light on how companies in an emerging market context navigate the complexities of integrated sustainability practices.

Table 1 illustrates the number of economic disclosures made by each company and their

percentage in the total. A total of 262 economic disclosures were identified across the 46 companies.

Table 1. Economic Disclosures Published by Companies in Their Sustainability Reports

Company	Number of Economic Disclosures	Percentage in Total
Company 1	13	4.96%
Company 2	9	3.44%
Company 3	10	3.82%
Company 4	13	4.96%
Company 5	9	3.44%
Company 6	4	1.53%
Company 7	1	0.38%
Company 8	7	2.67%
Company 9	7	2.67%
Company 10	2	0.76%
Company 11	3	1.15%
Company 12	12	4.58%
Company 13	4	1.53%
Company 14	4	1.53%
Company 15	4	1.53%
Company 16	3	1.15%
Company 17	4	1.53%
Company 18	17	6.49%
Company 19	2	0.76%
Company 20	1	0.38%
Company 21	2	0.76%
Company 22	3	1.15%
Company 23	13	4.96%
Company 24	2	0.76%
Company 25	6	2.29%
Company 26	5	1.91%
Company 27	10	3.82%
Company 28	1	0.38%
Company 29	12	4.58%
Company 30	9	3.44%
Company 31	8	3.05%
Company 32	5	1.91%
Company 33	3	1.15%
Company 34	9	3.44%
Company 35	4	1.53%
Company 36	3	1.15%
Company 37	2	0.76%
Company 38	6	2.29%
Company 39	0	0.00%
Company 40	5	1.91%
Company 41	2	0.76%
Company 42	2	0.76%
Company 43	10	3.82%
Company 44	3	1.15%
Company 45	1	0.38%
Company 46	7	2.67%
Total	262	100%

The data shows that the distribution of economic disclosures is uneven, with certain companies reporting significantly more disclosures than others. Company 18 leads with 17 disclosures, constituting 6.49% of the total. Companies with higher economic disclosures may have robust financial performance or a stronger commitment to transparency in financial reporting.

Interestingly, smaller companies or those in sectors with less financial reporting focus tend to disclose fewer economic metrics. This disparity underscores the need for standardized guidelines to ensure consistency across industries. It also suggests that companies with more resources may be better equipped to adopt comprehensive reporting practices.

The concentration of economic disclosures among a few companies reflects broader patterns in sustainability reporting, where economic performance often takes precedence due to its direct relevance to investors. However, it also highlights the potential for these companies to serve as benchmarks for others, promoting best practices in economic transparency.

Table 2. Top 5 Companies that Have Number of Economic Disclosures

Company	Number of Economic Disclosures
Company 18	17
Company 1	13
Company 4	13
Company 23	13
Company 12	12

Table 2 shows the top 5 companies with the most economic disclosures. Company 18 leads with 17 disclosures, followed by Companies 1, 4, and 23, each of which has reported 13 economic disclosures. Company 12 rounds out the top five with 12 disclosures. The higher number of economic disclosures from these companies may indicate that they place a strong emphasis on financial transparency and accountability, aligning with the strategic focus of larger, more resource-rich firms. This suggests that businesses with better financial performance or greater access to reporting resources are more likely to provide detailed economic data in

their sustainability reports. The significant variation in disclosures across companies highlights the inconsistency in reporting practices, with companies like Company 18 showing a model of transparency that could serve as a benchmark for others in the industry.

Environmental disclosures, as shown in Table 3, constitute a significant portion of the sustainability reports analyzed. A total of 777 disclosures were made across the 46 companies, reflecting the growing importance of environmental sustainability in corporate reporting.

Table 3. Environmental Disclosures Published by Companies in Their Sustainability Reports

Company	Number of Environmental Disclosures	Percentage in Total
Company 1	26	3,35%
Company 2	17	2,19%
Company 3	18	2,32%
Company 4	23	2,96%
Company 5	19	2,45%
Company 6	14	1,80%
Company 7	11	1,42%
Company 8	24	3,09%
Company 9	15	1,93%
Company 10	14	1,80%
Company 11	6	0,77%
Company 12	23	2,96%
Company 13	20	2,57%
Company 14	21	2,70%
Company 15	6	0,77%
Company 16	17	2,19%
Company 17	10	1,29%
Company 18	32	4,12%
Company 19	8	1,03%
Company 20	8	1,03%
Company 21	18	2,32%
Company 22	19	2,45%
Company 23	25	3,22%
Company 24	10	1,29%
Company 25	19	2,45%
Company 26	20	2,57%
Company 27	27	3,47%
Company 28	19	2,45%
Company 29	23	2,96%
Company 30	10	1,29%
Company 31	11	1,42%
Company 32	10	1,29%
Company 33	17	2,19%
Company 34	16	2,06%

Company 35	26	3,35%
Company 36	19	2,45%
Company 37	18	2,32%
Company 38	16	2,06%
Company 39	14	1,80%
Company 40	20	2,57%
Company 41	9	1,16%
Company 42	3	0,39%
Company 43	26	3,35%
Company 44	17	2,19%
Company 45	15	1,93%
Company 46	18	2,32%
Total	777	100%

As seen in Table 3, Company 18 also leads in environmental disclosures, contributing 4.12% of the total. Companies 27, 1, 43, and 35 are among the top contributors, each reporting over 25 environmental disclosures. This trend indicates a strong commitment to addressing environmental impacts, particularly among companies in industries with high environmental stakes, such as manufacturing and energy.

Notably, some companies reported significantly fewer environmental metrics, which may reflect variations in industry regulations, stakeholder pressures, or internal prioritization of environmental issues. For example, firms in the service sector may perceive environmental disclosures as less directly relevant to their operations.

The emphasis on environmental reporting aligns with global trends, where climate change and resource management are key concerns for stakeholders. Companies that disclose comprehensive environmental metrics are likely responding to increasing regulatory pressures and investor demands for greater accountability in this domain.

Table 4 presents data on the top 5 companies with the highest number of environmental disclosures:

Table 4. Top 5 Companies that Have Number of Environmental Disclosures

Top 5 Companies	Number of Environmental Disclosures
Company 18	32
Company 27	27
Company 1	26
Company 43	26
Company 35	26

As seen in Table 4, the top 5 companies with the most environmental disclosures are Company 18, with 32 disclosures, followed closely by Companies 27, 1, 43, and 35, each with 26 or 27 disclosures. This strong emphasis on environmental disclosures from these companies could be attributed to their operations in industries with significant environmental impacts, such as manufacturing, energy, or natural resources. It is clear that these firms are responding to increasing regulatory pressures and stakeholder expectations related to environmental responsibility. The prominence of Company 18 as the leader in environmental disclosures could reflect a company-wide sustainability strategy, likely incorporating climate risk management, resource efficiency, and environmental impact reduction. These findings are in line with global trends where companies in high-impact sectors are expected to be more transparent about their environmental footprint. However, it is also worth noting that some companies, particularly those in service-based industries, report fewer environmental disclosures, indicating that environmental issues may not be perceived as directly relevant to their business models.

Social disclosures dominate the sustainability reports, with 889 disclosures identified, as shown in Table 5. This finding indicates a strong emphasis on social responsibility among the sampled companies.

Table 5. Social Disclosures Published by Companies in Their Sustainability Reports

Companies	Number of Social Disclosures	Percentage in Total
Company 1	29	3,26%
Company 2	11	1,24%
Company 3	16	1,80%
Company 4	33	3,71%
Company 5	34	3,82%
Company 6	12	1,35%
Company 7	16	1,80%
Company 8	27	3,04%
Company 9	12	1,35%
Company 10	15	1,69%
Company 11	19	2,14%
Company 12	16	1,80%
Company 13	25	2,81%
Company 14	21	2,36%
Company 15	20	2,25%
Company 16	19	2,14%

Company 17	12	1,35%
Company 18	40	4,50%
Company 19	12	1,35%
Company 20	12	1,35%
Company 21	16	1,80%
Company 22	15	1,69%
Company 23	29	3,26%
Company 24	13	1,46%
Company 25	20	2,25%
Company 26	12	1,35%
Company 27	22	2,47%
Company 28	17	1,91%
Company 29	27	3,04%
Company 30	27	3,04%
Company 31	23	2,59%
Company 32	17	1,91%
Company 33	14	1,57%
Company 34	26	2,92%
Company 35	31	3,49%
Company 36	17	1,91%
Company 37	13	1,46%
Company 38	20	2,25%
Company 39	2	0,22%
Company 40	33	3,71%
Company 41	15	1,69%
Company 42	10	1,12%
Company 43	25	2,81%
Company 44	14	1,57%
Company 45	14	1,57%
Company 46	16	1,80%
Total	889	100%

Company 18 again leads in this dimension, reflecting its comprehensive approach to sustainability reporting (Table 5). Other high contributors, such as Companies 5, 4, 40, and 35, also demonstrate a strong commitment to social metrics, focusing on issues like labor practices, community engagement, and human rights.

The prominence of social disclosures may be attributed to their relevance to stakeholders, particularly employees, local communities, and advocacy groups. Companies with strong social disclosures likely view these metrics as integral to building trust and enhancing their corporate reputation.

However, the uneven distribution of disclosures across companies suggests that some firms may still view social issues as peripheral to their core operations. This disparity underscores the need for greater awareness and capacity-building initiatives

to encourage broader adoption of comprehensive social reporting practices.

Table 6 provides data on the top 5 companies with the highest number of social disclosures:

Table 6. Top 5 Companies that Have Number of Social Disclosures

Top 5 Companies	Number of Social Disclosures
Company 18	40
Company 5	34
Company 4	33
Company 40	33
Company 35	31

Table 6 illustrates the top 5 companies with the most social disclosures. Company 18 again leads with 40 disclosures, followed by Company 5 with 34, and Companies 4, 40, and 35, all reporting 31 or more social disclosures. This emphasis on social disclosures indicates a strong focus on labor practices, human rights, community engagement, and other social responsibility issues.

Companies like Company 18, with the highest number of disclosures, likely recognize the value of transparent social reporting in building strong relationships with their stakeholders, including employees, local communities, and customers. Social sustainability has gained prominence as a key area of corporate responsibility, and these companies are taking proactive steps to report their performance in this domain.

The substantial number of social disclosures from Company 5 and others suggests a growing recognition that social issues directly impact long-term business success. This trend is particularly relevant in industries where human capital and community engagement are critical to operational success.

In accordance with the general statistical parameters delineated in the sustainability reports, a series of hypotheses were formulated within the context of the study to ascertain the interconnections between the frequencies of economic, environmental, and social disclosures. These hypotheses were subsequently subjected to empirical testing.

The initial objective was to ascertain whether a correlation exists between the number of economic, environmental, and social disclosures included in the sustainability reports published by the companies in question. The H1 hypothesis, formulated for the purposes of this study, is presented below:

H1: There is a relationship between the numbers of economic, environmental, and social disclosures included in the sustainability reports published by the companies.

The Pearson correlation test was employed to assess the veracity of the H1 hypothesis. The statistical data obtained from the test results are presented in Table 7.

Table 7. Statistics of the Correlation Between the Number of Economic, Environmental and Social Disclosures

Variables	Statistics	Economic Disclosures	Environmental Disclosures	Social Disclosures
Economic Disclosures	Pearson Correlation	1	,625**	,677**
	Sig. (2-tailed)		,000	,000
	N	46	46	46
Environmental Disclosures	Pearson Correlation	,625**	1	,589**
	Sig. (2-tailed)	,000		,000
	N	46	46	46
Social Disclosures	Pearson Correlation	,677**	,589**	1
	Sig. (2-tailed)	,000	,000	
	N	46	46	46

As demonstrated in Table 7, the calculated significance values are less than 0.05, indicating a statistically significant relationship between all

economic, environmental, and social disclosure variables. In light of these findings, the H1 hypothesis can be accepted. The analysis indicates the presence

of statistically significant positive correlations across the full range of variables within each of the three dimensions. The strong correlation between economic and social disclosures ($r = 0.677$) indicates that companies with comprehensive economic reporting are more likely to prioritize social responsibility initiatives. Similarly, the correlation between economic and environmental disclosures ($r = 0.625$) underscores the financial implications of environmental sustainability.

These findings reinforce the interconnected nature of sustainability dimensions, aligning with the principles of the Triple Bottom Line framework. Companies that integrate these dimensions into their reporting practices are better positioned to address stakeholder expectations and achieve long-term sustainability goals.

Following the determination of the relationship between the number of economic, environmental, and social disclosures, an investigation was conducted to ascertain whether these variables exert an influence on one another. The initial investigation sought to ascertain whether the number of environmental disclosures exerts an influence on the number of economic disclosures. The second hypothesis, formulated for the purpose of this investigation, is presented below:

H2: Environmental disclosures have a significant effect on economic disclosures included in the sustainability reports published by the companies.

The H2 hypothesis was tested using a simple linear regression test. The statistical data obtained from the test results are presented in Table 8.

Table 8. Regression Analysis Results on the Impact of Environmental Disclosure Numbers on Economic Disclosure Numbers

Independent Variable	R Square	Significance value of the model	Standardized Coefficients Beta Value	Coefficients Significance Value
Environmental Disclosures	.390	.000	.625	.000
Dependent Variable: Economic Disclosures				

The results demonstrate that environmental disclosures exert a considerable positive influence on economic disclosures ($R^2 = 0.390$, $p < 0.01$). Consequently, the H2 hypothesis was accepted. This finding suggests that companies investing in environmental initiatives are more likely to report robust economic performance, reflecting the financial benefits of environmental sustainability practices.

Subsequently, an investigation was conducted to ascertain whether the number of social disclosures

has an impact on the number of economic disclosures. The H3 hypothesis, formulated for this purpose, is presented below:

H3: Social disclosures have a significant effect on economic disclosures included in the sustainability reports published by the companies.

The H3 hypothesis was tested using a simple linear regression. The statistical data obtained from the test results are presented in Table 9.

Table 9. Regression Analysis Results on the Impact of Social Disclosure Numbers on Economic Disclosure Numbers

Independent Variable	R Square	Significance value of the model	Standardized Coefficients Beta Value	Coefficients Significance Value
Social Disclosures	.459	.000	.677	.000
Dependent Variable: Economic Disclosures				

Similarly, social disclosures exert a considerable influence on economic disclosures ($R^2 = 0.459$, $p < 0.01$). Consequently, the H3 hypothesis was accepted. This relationship underscores the pivotal role of social initiatives in driving financial performance, thereby reinforcing the argument that corporate responsibility enhances stakeholder trust and economic resilience.

Implications

The findings of this section underscore the importance of integrating economic, environmental, and social dimensions in sustainability reporting. Companies that adopt a balanced approach to these disclosures are better equipped to meet stakeholder expectations, align with global sustainability goals, and achieve long-term success. The analysis also highlights the need for standardized guidelines and capacity-building initiatives to promote consistent and comprehensive reporting practices across industries. These findings are particularly relevant in emerging markets, where the integration of sustainability practices is still evolving.

The significant variation in the number of disclosures across companies, as shown in the tables, suggests that while certain companies excel in reporting on economic, environmental, and social dimensions, others demonstrate room for improvement. Such discrepancies underscore the need for more sector-specific frameworks and regulatory efforts to ensure that all companies, regardless of their size or sector, are held to similar standards of transparency and accountability.

Further research into the drivers behind these variations—such as industry, company size, or geographical location—could help explain these differences and provide actionable insights for enhancing sustainability reporting in specific sectors. Companies that demonstrate leadership in one dimension of sustainability could serve as benchmarks for others, encouraging best practices and advancing the integration of sustainability reporting as a core aspect of corporate strategy.

4. CONCLUSION

This study explores the integration of economic, environmental, and social dimensions within sustainability reporting by analyzing the disclosures of 46 Borsa Istanbul (BIST)-listed companies in their 2021 sustainability reports prepared in accordance with Global Reporting Initiative (GRI) standards. The findings reveal significant interrelationships between these dimensions and emphasize the critical role of comprehensive and balanced reporting in achieving corporate sustainability objectives. This conclusion discusses the study's importance, its relevance to academic and practical fields, its contribution to the sustainability literature, and the opportunities it presents for further research.

The findings of this study are both timely and relevant given the growing global emphasis on corporate accountability and transparency in sustainability practices. The observed relationships between economic, environmental, and social disclosures underscore the interconnected nature of these dimensions, aligning with the principles of the Triple Bottom Line framework. The study demonstrates that companies focusing on social and environmental disclosures are more likely to achieve robust economic performance, suggesting that sustainability practices are not merely ethical or compliance obligations but strategic imperatives that contribute to long-term financial resilience and profitability. These insights have practical implications for corporate managers, policymakers, and other stakeholders striving to integrate sustainability into their organizational strategies.

One of the key contributions of this study is its empirical validation of the interdependence between sustainability dimensions. Prior literature has often discussed these relationships theoretically, but empirical evidence has been relatively scarce, particularly in the context of developing economies. By focusing on BIST-listed companies, the study highlights how firms operating in an emerging market context approach sustainability reporting. The findings reveal that while social disclosures dominate, followed by environmental and economic disclosures, there is still room for more balanced

reporting practices. This imbalance reflects the broader challenges faced by companies in integrating the three sustainability dimensions effectively, offering a nuanced understanding of how such practices vary across different organizational and cultural contexts.

The study contributes to the existing literature by addressing a significant gap in understanding the integration of economic, environmental, and social disclosures in sustainability reports. Previous research has primarily examined the individual dimensions of sustainability or focused on specific industries or regions. This study expands the scope by exploring the interplay between these dimensions within a single framework, providing a holistic perspective on sustainability reporting. By employing robust analytical methods such as correlation and regression analyses, the study offers empirical support for the argument that environmental and social initiatives are integral to economic success. This contribution is particularly relevant as organizations worldwide increasingly adopt sustainability practices as part of their strategic goals.

Furthermore, the study highlights the practical challenges and opportunities associated with sustainability reporting. The variation in disclosure frequencies among the sampled companies suggests that while some organizations recognize the importance of sustainability reporting, others face significant barriers, such as resource constraints, limited awareness, or lack of standardized guidelines. The findings emphasize the need for more sector-specific frameworks and capacity-building initiatives to encourage broader adoption of comprehensive reporting practices. Policymakers and regulatory bodies can use these insights to design incentives and guidelines that promote balanced and transparent reporting across industries.

The importance of this study also lies in its ability to guide practitioners. For corporate managers, the findings underscore the strategic value of integrating sustainability dimensions into their reporting practices. Companies that adopt a balanced approach to economic, environmental, and social disclosures

are better positioned to meet stakeholder expectations, enhance their market reputation, and achieve sustainable growth. For investors and other stakeholders, the study provides a framework for assessing corporate sustainability practices, enabling more informed decision-making.

While this study offers significant contributions, it also highlights opportunities for further research. First, the study is limited to the sustainability reports of BIST-listed companies for 2021, providing a snapshot of reporting practices within a specific context and time frame. Future research could expand this scope by conducting longitudinal studies to examine how disclosure practices evolve over time. Such research could identify trends and assess the impact of regulatory changes, stakeholder pressures, and global sustainability initiatives on corporate reporting.

Second, the study focuses on companies in Turkey, an emerging market with unique economic, regulatory, and cultural characteristics. Comparative studies across countries or regions could provide valuable insights into how different contexts influence sustainability reporting practices. For instance, examining the adoption of GRI standards in developed versus developing economies could reveal variations in priorities, challenges, and opportunities. This approach would contribute to the global discourse on sustainability and inform the development of more inclusive and adaptable reporting frameworks.

Third, the study primarily relies on quantitative analyses of disclosure frequencies, which provide valuable insights into the relationships between sustainability dimensions but do not capture the qualitative aspects of reporting. Future research could employ mixed-methods approaches to analyze the content and depth of sustainability disclosures, exploring how companies communicate their sustainability strategies, achievements, and challenges. This qualitative perspective could complement the quantitative findings, offering a more comprehensive understanding of reporting practices.

Finally, the study's focus on the GRI framework provides a solid foundation for analyzing sustainability reports, but it also opens avenues for exploring alternative or complementary frameworks. The adoption of emerging standards such as the Task Force on Climate-related Financial Disclosures (TCFD) and the International Integrated Reporting Council (IIRC) framework could be examined to assess their impact on reporting practices and corporate performance. Additionally, future research could investigate the integration of digital technologies such as artificial intelligence and blockchain in sustainability reporting, exploring their potential to enhance transparency, accuracy, and stakeholder engagement.

In conclusion, this study underscores the importance of integrating economic, environmental, and social dimensions into sustainability reporting, highlighting their interdependence and strategic value. It contributes to the literature by providing empirical evidence on the relationships between these dimensions and offering practical insights for businesses and policymakers. By addressing the challenges and opportunities associated with sustainability reporting, the study lays the groundwork for future research that can further advance understanding and practice in this critical area. As organizations continue to navigate the complexities of sustainability, studies like this will play a pivotal role in shaping the future of corporate accountability and sustainable development.

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NAVIGATING DIGITAL TRANSFORMATION: EXPLORING THE NEXUS BETWEEN DIGITAL LEADERSHIP AND JOB SATISFACTION

Tolga ALTINTAS*

Merve Nur YARANGÜME**

İsa İPCİOĞLU***

- * Corresponding Author, Research Assistant, Bilecik Şeyh Edebali University, Faculty of Economics and Administrative Sciences, Business Administration, tolga.altintas@bilecik.edu.tr, <https://orcid.org/0000-0003-0765-6195>.
- ** Bilecik Şeyh Edebali University, Institute of Social Sciences, mervenuryarangume811881@gmail.com, <https://orcid.org/0009-0001-0740-3158>.
- *** Prof. Dr., Bilecik Şeyh Edebali University, Faculty of Economics and Administrative Sciences, Business Administration, isa.ipcioglu@bilecik.edu.tr, <https://orcid.org/0000-0002-6912-3290>.

ABSTRACT

The global impact of digitalization is a phenomenon that affects businesses in a multitude of ways. It is imperative that businesses undergo digital transformation across all business processes, with leaders playing a pivotal role in ensuring this transformation occurs. It is hypothesized that those in leadership positions will gain a competitive advantage by implementing digital transformation across the entire organization. This study explores the interplay between digital leadership and job satisfaction, emphasizing the pivotal role of leaders in navigating organizational transformation in the digital age. By synthesizing recent literature, the research identifies a positive correlation between digital leadership practices and employee satisfaction. Digital leadership, characterized by technological expertise and human-centric approaches, fosters innovation, enhances employee motivation, and mitigates resistance to change. Despite its relevance, the relationship remains underexplored, with limited empirical evidence addressing mediating variables and contextual factors. This review aims to enrich the academic discourse by highlighting practical implications for leadership development and future research directions.

Keywords: Digital Transformation, Digital Leadership, Job Satisfaction, Organizational Transformation.

1. INTRODUCTION

The advent of digital technologies has instigated a profound transformation in organizational structures and processes. As businesses adapt to this evolving landscape, digital leadership has emerged as a cornerstone of effective digital transformation. Leaders equipped with the skills to integrate technological advancements with organizational strategies play a crucial role in fostering innovation, efficiency, and workforce adaptability (Ordu & Nayır, 2021; Goran et al., 2017). Digital transformation, while offering substantial opportunities, also presents challenges that demand visionary and adaptable leadership (Hensellek, 2020).

Digital leadership represents a shift from traditional leadership paradigms, emphasizing technological acumen alongside interpersonal skills. The

integration of digitalization into a business increases the communication of that organization at the administrative level (Dijkstra, J., 2020). Leaders in this domain are tasked not only with adopting innovative technologies but also with guiding their teams through cultural and operational changes necessitated by digitalization (Sow & Aborbie, 2018; Westerman et al., 2014). Leadership has been identified as a key factor influencing the perception of organizational policies and their subsequent impact on employee job satisfaction levels (Ferris & Fandt, 1989). Their ability to balance technological proficiency with a people-centered approach often determines the success of transformation initiatives. In addition to driving technological change, digital leaders must also address employee concerns, foster inclusivity, and ensure that organizational goals align

with employee aspirations (Hensellek, 2020; Cortellazzo et al., 2019).

Amid the rapid pace of digitalization, job satisfaction remains a cornerstone of organizational success. Defined as the degree to which employees feel fulfilled and motivated in their roles, job satisfaction directly impacts performance, retention, and overall organizational health (Locke, 1969; Spector, 1985). Historically, leadership styles such as transformational, participatory, and ethical leadership have been linked to higher levels of job satisfaction (Bogler, 2001; Barker & Nelson, 2005). However, the rise of digital leadership introduces new dynamics into this relationship, as digital transformation reshapes not only workflows but also the expectations and experiences of employees (Şahin et al., 2020; Topçuoğlu et al., 2023).

The integration of digital tools and platforms has heightened the importance of effective leadership in managing employee expectations and mitigating resistance to change. Digital leaders engage in activities at three distinct levels. They endeavour to cultivate and reinforce the personal competencies of their personnel, provide their subordinates with opportunities to expand their knowledge base, facilitate consensus within the team, and disseminate external information to their followers (Zupancic et al., 2018).

Digital leaders who demonstrate empathy, adaptability, and a clear vision can enhance job satisfaction by aligning organizational processes with employee needs (El Sawy et al., 2016; Artüz & Bayraktar, 2021). Conversely, the absence of strong digital leadership can lead to dissatisfaction, manifesting as resistance to technological adoption, reduced morale, and decreased productivity (Haddud & McAllen, 2018).

Despite the growing recognition of digital leadership's importance, the interplay between digital leadership and job satisfaction remains underexplored in the literature. In the context of the digital age, the relationship between leaders and employees is of paramount importance in order to achieve favourable outcomes in the domain of digital leadership. However, existing studies have primarily

focused on the technical aspects of digital transformation, with limited attention to its human dimensions. Investigating this relationship is essential to understanding how leaders can foster a positive work environment amidst digital upheaval (Benitez et al., 2022; Pasolong et al., 2021).

This study synthesizes existing literature to examine the relationship between digital leadership and job satisfaction. The succeeding sections delve into the conceptual foundations of digital leadership and job satisfaction, followed by an analysis of their interrelationship. The discussion highlights empirical findings and identifies gaps in the literature, concluding with practical implications and recommendations for future research. By addressing these aspects, the study aims to provide a comprehensive understanding of the critical role digital leadership plays in shaping employee satisfaction within digitally transformed organizations.

2. DIGITAL LEADERSHIP

The term "leader" is traditionally defined as an individual who directs and inspires others toward achieving specific goals (Webster, 1994). Leaders play pivotal roles in organizations, driving motivation, facilitating change, fostering effective communication, and influencing employees' job satisfaction and organizational commitment (Tengilimoğlu, 2005).

While some argue that leadership qualities are innate, others emphasize the significant role of life experiences, particularly during formative years, in shaping an individual's leadership potential (Gün & Aslan, 2018). Leadership styles have evolved over time to address the demands of dynamic environments and technological advancements. Successful leaders exhibit adaptability and innovation, tailoring their approaches to align with contemporary organizational challenges (Bildik, 2009).

Traditional leadership paradigms—autocratic, bureaucratic, democratic, and charismatic—dominated for decades. However, the modern workplace has seen the emergence of ethical, transformational, participatory, and, more recently,

digital leadership styles, reflecting the increasing complexity and interconnectedness of the global landscape (Arslan et al., 2024).

The shift toward new leadership paradigms is not merely a reaction to changing organizational needs but also a response to broader societal transformations. The rise of knowledge economies, globalized workforces, and the integration of artificial intelligence and automation have necessitated leaders who can navigate complexity, foster innovation, and promote adaptability among employees.

2.1. The Emergence of Digital Leadership

The concept of digital leadership has emerged as a response to the unique challenges posed by the digital age. The transition from analog to digital technologies has resulted in profound transformations over the past seventy years, marking the advent of the digital age. This transition initiated what is now termed the Information Age, characterized by the rise of computers and associated software in the latter half of the 20th century (Ordu & Nayır, 2021).

Technological innovations underpinning this shift, which began during the Industrial Revolution, have culminated in significant structural changes that now define modern industries and societies (Wilson III, 2004). The introduction and proliferation of digital technology have had immediate and lasting impacts on nearly every aspect of people's lives globally, from communication to professional practices and beyond (Benson, 2018).

Despite periods of economic uncertainty and global crises, many international platforms have maintained a commitment to digital transformation, recognizing the economic and operational benefits of digitalization (Ordu & Nayır, 2021). Digital transformation is increasingly viewed as a strategic imperative for businesses, offering competitive advantages to organizations that successfully navigate the transition (Arslanhan Memiş, 2018). In today's digitally driven world, businesses that embrace digital innovation stand to gain significant advantages, including enhanced efficiency, improved

customer engagement, and expanded market reach (Bolte et al., 2018; Sheninger, 2014).

The pace of digital transformation has accelerated dramatically in recent years, particularly in response to the global SARS-CoV-2 pandemic, which underscored the critical need for technological adaptation (Yıkılmaz, 2021). Organizations were compelled to adopt digital strategies at unprecedented rates, revealing both the potential benefits and inherent challenges of this transition. One of the most difficult aspects of digital transformation lies in individual adaptation. The process is inherently time-consuming and often requires a combination of organizational alignment, leadership commitment, and external conditions that facilitate natural progression (MaryAnne, 2018).

2.2. The Role of Leadership in Digital Transformation

Digital leadership refers to a style of leadership that integrates technological expertise with traditional leadership competencies, emphasizing the ability to guide organizations through periods of technological and cultural change (Rudito & Sinaga, 2017). It involves aligning people with novel digital processes through motivation, influence, and a strategic vision (Meier, 2017).

Digital leadership is a pivotal component of organizational success in the digital age. By integrating technological expertise with strategic vision and human-centric approaches, digital leaders drive transformation, foster innovation, and ensure long-term organizational resilience (Shah & Patki, 2020). As the global business landscape continues to evolve, the role of digital leaders will remain critical in shaping the future of work and achieving sustainable success.

Leadership plays an essential role in the success of digital transformation efforts. The process necessitates a clear vision, strategic guidance, and the ability to inspire organizational alignment. Leaders act as catalysts for change, ensuring that both technological and human dimensions of transformation are addressed. Studies emphasize the critical role of leaders in motivating employees, reducing resistance to change, and fostering an

innovative culture that embraces digital processes (Ordu & Nayır, 2021; Sow & Aborbie, 2018). Without effective leadership, organizations may struggle to realize the full potential of digital transformation efforts. Furthermore, leadership has the capacity to minimise errors and enhance individual knowledge and growth opportunities for members (Braun et al., 2013).

2.3. The Rise of Digital Leadership

The rapid digitization of industries has redefined leadership paradigms, giving rise to digital leadership—a style that integrates technological expertise with adaptive and innovative approaches. Digital leaders are instrumental in guiding organizations through the complexities of digital transformation, leveraging technology to enhance performance and foster innovation.

Digital leadership is characterized by the strategic use of digital tools and systems to optimize operations, drive growth, and create competitive advantages. Leaders in this domain act as visionaries and coaches, facilitating digital transformation while ensuring alignment with organizational goals (Aslan, 2021; Klein, 2020). Mihardjo et al. (2019) describe digital leadership as an organizational competency that integrates advanced communication, computing, and telecommunications technologies. Likewise, it is also employed to describe a novel generation of leaders who deploy digital tools and inspire their employees to embrace digitalisation (Zeike et al., 2019). These leaders bridge the gap between technological advancements and employee capabilities, fostering a culture of continuous learning and adaptation.

Digital leadership is not limited to technological proficiency; it also entails emotional intelligence, ethical decision-making, and strategic vision. Effective digital leaders understand the human dimensions of technology adoption, ensuring that employees feel supported, valued, and empowered throughout the transformation process.

In essence, digital leadership can be defined as a style of leadership that leverages information technology to unite and mobilize a following, promoting the intelligent and productive use of technology (Asri &

Darma, 2020). Digital leaders demonstrate leadership across the entire value chain, aligning their actions with the latest developments in their field (Bowen, 2021). They play a pivotal role in bridging the gap between technological innovation and human adaptability, ensuring that employees are equipped to navigate the complexities of digital transformation (Cortelazzo et al., 2019). A digital leader's responsibilities extend beyond the implementation of new technologies; they also include fostering an inclusive culture that transcends barriers such as religion, language, and race, thereby ensuring collective alignment with organizational objectives (Winston & Patterson, 2006).

Traditional models of leadership are often insufficient in addressing the dynamic challenges of the digital age. Consequently, organizations must adopt alternative paradigms that prioritize collaboration, technological integration, and strategic adaptability (Malakyan, 2019). Compared to traditional leaders, digital leaders exhibit a greater proclivity for collaboration and demonstrate a stronger orientation towards leveraging technology for business success (Hearsum, 2015; Temelkova, 2018).

Digital leadership, as defined by Şahin et al. (2020), combines digital tools and resources with strategic and managerial thinking to achieve organizational objectives in a rapidly changing world. El Sawy et al. (2016) further describe digital leadership as a strategic approach that ensures organizational success by addressing environmental factors and leveraging digital tools.

2.4. Addressing Challenges in Digital Leadership

Digital leaders face unique challenges, particularly in addressing the apprehensions of employees regarding digital transformation. A study by the German Federal Ministry of Education and Research (BMBF, 2017) found that 60% of employees fear job losses due to digitalization and automation. Digital leaders must address these concerns by fostering a balance between technological advancements and workforce well-being. Ensuring that employees feel supported and valued is critical to minimizing resistance and maximizing engagement throughout

the transformation process (Teichmann & Hüning, 2018).

In addition to managing workforce concerns, digital leaders must navigate the risks and opportunities associated with technological integration. They are responsible for implementing innovative approaches, driving productivity, and ensuring ethical considerations are prioritized in decision-making processes (Baker & Nelson, 2005; Hensellek, 2020).

2.5. Characteristics of Effective Digital Leaders

Effective digital leaders possess a distinct set of attributes that enable them to navigate the complexities of the digital age successfully. In a study conducted on digital leadership, the characteristics deemed essential for a digital leader were identified as honesty and transparency, exemplary conduct, a clear vision, fairness, guidance, individual interest, openness to innovation, and a high level of knowledge (Toduk, 2017). In another study addressing the concepts associated with digital leadership in the context of management sciences, it is asserted that digital leadership is linked to a range of factors, including the characteristics of leaders, an innovative approach to business, success, and a technology adaptation model (Ercan Önbiçak & Akkoyun, 2022).

In a further study of digital leadership, the concept of digitalization was examined, as well as its impact on the characteristics of leaders and the skills and competencies required of those in positions of authority. The majority of these were found to be conceptual in nature (Özmen et al., 2020). The literature on digital leadership commonly identifies the following characteristics as being particularly prevalent among those who can be considered digital leaders:

Technological Proficiency: A deep understanding of digital tools and platforms is essential for making informed decisions and driving innovation (Mert, 2021).

Vision and Strategic Thinking: Digital leaders must articulate a clear vision for the future, aligning

organizational efforts with long-term objectives and market trends (Daud et al., 2021).

Adaptability: The ability to respond to changing circumstances and embrace new challenges is crucial in navigating the dynamic digital landscape (Promsri, 2019; Kane et al., 2019).

Collaboration and Communication: Digital leaders foster teamwork and ensure open communication across organizational hierarchies, facilitating alignment and engagement (Çelik Şahin et al., 2020; Kellogg et al., 2020).

Cultural Intelligence: Recognizing and valuing diversity within globalized work environments is essential for fostering inclusivity and innovation (Miller, 2018).

Soft Skills: Digital leadership is a combination of soft skills, including ethical responsibility and agility (Herold, 2016).

2.6. The Impact of Digital Leadership

Digital leadership significantly influences organizational success by enhancing operational efficiency, fostering innovation, and driving employee engagement. By integrating digital technologies, organizations can streamline workflows, reduce human error, and meet evolving customer expectations (Freitas Junior et al., 2020). Digital leaders also play a critical role in fostering a positive organizational culture, motivating employees, and driving productivity.

Furthermore, digital leadership enhances an organization's competitive advantage by enabling it to capitalize on global market opportunities. Digital leaders are adept at identifying emerging trends, aligning organizational strategies with market demands, and navigating the complexities of global competition (Jäckli & Meier, 2020).

2.7. Challenges and Barriers

Despite its potential, digital leadership presents challenges. Many organizations struggle with the implementation of digital transformation initiatives due to leadership deficits, resistance to change, and insufficient stakeholder engagement (Correani et al., 2020). Effective digital leaders must possess the

knowledge, experience, and interpersonal skills necessary to overcome these barriers and drive successful transformation efforts (Haddud & McAllen, 2018).

A key distinction between leaders and employees in digital organizations lies in their approach to transformation (Altıntaş & İpcioğlu, 2024). While employees adapt to new technologies, leaders are responsible for orchestrating these changes, demonstrating digital competencies, and ensuring alignment with organizational objectives (Matt et al., 2015).

3. JOB SATISFACTION

The term "job satisfaction" is often used interchangeably with similar concepts, marking its origins in academic studies dating back to the 1920s (Gafa & Dikmenli, 2019). The concept was formally introduced in 1931 through organizational research conducted by Fisher and Hanna. Locke (1969) later theorized that employees exhibit greater happiness and productivity when assigned tasks aligned with their character and competencies. He described this alignment as "job satisfaction" and associated it with the notion of fulfilling and agreeable work.

While the term first emerged in the 1920s, the broader implications of job satisfaction, particularly its positive influence on employees' physical and mental well-being, became evident by the 1940s. These findings reinforced the concept's importance in organizational contexts, leading to continued exploration and development (Spector, 1985). By 1971, Churchill and colleagues advanced the field by publishing seminal research on measuring job satisfaction, directly linking it to job definitions and the work environment (Zhu, 2013).

Job satisfaction can be conceptualized as an individual's overall attitude and behavior toward their profession. It embodies the internal peace and contentment experienced by employees in relation to their roles. Positive attitudes toward work reflect job satisfaction, whereas negative attitudes indicate job dissatisfaction (Üçüncü, 2016). This construct can also be described as the emotional state arising from the congruence between an individual's work-life conditions and their positive perception of their

occupation (Ughoro & Obeng, 2000). Additionally, job satisfaction encapsulates the benefits derived from one's role, fostering a harmonious and joyful work environment through effective collaboration with colleagues (Bingöl, 1997).

The attainment of job satisfaction is linked to personal success and internal serenity (Kaliski, 2007). Conversely, job dissatisfaction often precipitates adverse outcomes, such as absenteeism and an inclination to resign, leading to substantial organizational costs (Çarıkçı & Çelikkol, 2009). Job dissatisfaction can significantly affect organizational performance, reducing employee motivation and productivity. It may also increase employee turnover and intra-organizational conflicts, ultimately resulting in considerable financial and operational losses for the organization (Şimşir & Seyran, 2020).

3.1. Factors Influencing Job Satisfaction

Several organizational factors contribute to job satisfaction, with the nature of the job itself being a critical determinant. The degree to which employees enjoy their roles and perceive them as aligned with their abilities and preferences is fundamental to their overall satisfaction (Altundaş, 2000). In the literature, wage levels are emphasized as a direct correlate of job satisfaction (Andrews, 2003).

Working conditions also play a pivotal role. Elements such as occupational health, safety, and overall workplace comfort are significant contributors to job satisfaction (İşcan & Sayın, 2011). Effective organizations strive to create environments that prioritize employee well-being by safeguarding against environmental hazards, ensuring quiet workspaces, using safe machinery, and maintaining a radiation-free workplace (Bingöl, 2003).

Promotion opportunities represent another influential factor. The potential for career advancement within an organization has been shown to enhance both job satisfaction and motivation. Crucially, promotion processes must be perceived as fair and equitable (İşcan & Sayın, 2011). Career progression not only increases employees' sense of responsibility but also positively impacts their social environment and professional standing (Robbins, 2001).

Moreover, the quality of interpersonal relationships within the workplace significantly influences job satisfaction. Positive interactions among employees facilitate equitable workload distribution and foster a sense of social cohesion, thereby enhancing productivity and maximizing employee happiness and motivation (Sabuncuoğlu, 2001).

3.2. Perspectives on Job Satisfaction

Numerous scholars have offered definitions of job satisfaction, emphasizing its multifaceted nature. Bullock conceptualized job satisfaction as an attitude shaped by a synthesis of various work-related experiences (Çalışkan, 2005). The emotional and character-driven dimensions of job satisfaction are further highlighted in the literature, underscoring the individual variability in its perception (Üçüncü, 2016).

Eren (2001) proposed that job satisfaction encompasses not only financial compensation but also the fulfillment derived from harmonious relationships with colleagues and the successful execution of one's responsibilities. Weiss (2008) posited that job satisfaction is an objective evaluation rather than a mere emotional response, aligning with Liess and Judge's (2004) assertion that it reflects an individual's attitudes toward their occupational role.

Davis (1988) defined job satisfaction as the emotional response—either happiness or unhappiness—experienced by employees in their professional capacities. Statt (2004) further elaborated on this idea, describing job satisfaction as the extent to which individuals feel gratified by the rewards they receive for their work. George & Jones (2008) emphasized that job satisfaction encompasses the aggregate of feelings associated with occupational roles, influenced by factors such as job characteristics, interpersonal relationships, and communication with superiors.

Mullins (2005) observed that perceptions of job satisfaction vary across individuals, shaped by their internal experiences and emotional states. Aziri (2008) described job satisfaction as an emotional state arising from the perception that one's job meets both material and psychological needs. This sentiment is vital for both employees and

organizations, as high levels of job satisfaction correlate with increased productivity, openness to change, and reduced turnover. For instance, during the COVID-19 pandemic, employees with high job satisfaction demonstrated resilience and adaptability to rapidly changing workplace dynamics, maintaining their commitment to their roles (Hamzah et al., 2021; Marbawi et al., 2022; Muniroh et al., 2021).

3.3. Consequences of Job Dissatisfaction

Job dissatisfaction, at the individual level, manifests as withdrawal behaviors, emotional distress, and instability. Employees experiencing dissatisfaction may display unfriendliness, preoccupation with personal concerns, and diminished focus on their work. Prolonged dissatisfaction can lead to psychological disorders (Üçüncü, 2016).

At the organizational level, job dissatisfaction results in adverse outcomes such as high turnover rates, increased absenteeism, frequent errors, and strained employer-employee relations. These challenges contribute to declining workplace performance and significant financial losses for the organization. In addition, dissatisfaction exacerbates workplace conflicts and undermines overall team morale, posing long-term risks to organizational success (Üçüncü, 2016).

4. THE RELATIONSHIP BETWEEN DIGITAL LEADERSHIP AND JOB SATISFACTION

The relationship between digital leadership and job satisfaction is a burgeoning area of inquiry, reflecting the transformative impact of technology on leadership dynamics and employee experiences (Al-Hussami, 2008). Digital leaders, by integrating technological expertise with empathetic practices, influence various aspects of employee satisfaction. Digital leadership represents a transformative approach to management, integrating technology, innovation, and employee engagement. By fostering supportive and efficient workplace environments, digital leaders enhance job satisfaction, drive performance, and contribute to organizational success. Empirical evidence underscores the universal relevance of digital leadership across industries, regions, and cultural contexts

(Cortellazzo, 2019). As organizations continue to embrace digital transformation, the role of digital leaders will become increasingly critical. Their ability to inspire, innovate, and adapt will not only shape the future of work but also ensure sustainable organizational growth in an ever-changing global landscape (Kane et al., 2015).

4.1. Leadership Styles and Their Impact on Job Satisfaction

Job satisfaction, a critical factor in organizational success, is deeply influenced by leadership styles and behaviors. Leaders significantly shape their employees' attitudes, motivations, and perceptions of their work environment (Radulescu et al., 2020). Research has consistently demonstrated that positive perceptions of leadership are associated with higher levels of job satisfaction (Yalçıntaş & Eren, 2017). For instance, when leaders adopt positive behavioral changes, their actions tend to foster greater satisfaction among employees (Karaduman, 2002).

People-oriented leadership approaches, as highlighted by Bogler (2001), are particularly effective in enhancing job satisfaction, as they prioritize employee well-being and engagement. Similarly, ethical leadership fosters satisfaction by aligning business goals with staff encouragement and support (Bello, 2012; Brown et al., 2005; Zhou et al., 2015). Leadership behaviors characterized by paternalism, such as providing protection and support to employees, also correlate positively with job satisfaction (Pellegrini & Scandura, 2008; Anwar, 2013).

Ethical leadership, which emphasizes fairness, integrity, and respect, has been consistently linked to enhanced job satisfaction. Leaders who adopt ethical principles inspire trust and loyalty among employees, creating a positive workplace culture (Bello, 2012; Brown et al., 2005; Zhou et al., 2015). Similarly, paternalistic leadership, characterized by protective and nurturing behaviors, meets employees' emotional and professional needs, thereby boosting satisfaction levels (Pellegrini & Scandura, 2008).

Transformational leaders, who encourage innovation, adaptability, and competitiveness, create an environment where employees develop positive

attitudes toward their roles, thereby enhancing job satisfaction (Bushra et al., 2011). Likewise, visionary leaders who mitigate employee uncertainties positively influence satisfaction levels (Yılmaz & Karahan, 2010). A dual focus on people- and task-oriented leadership has been identified as the most conducive to job satisfaction, as noted by Barker et al. (2007) and Önder (2010). This approach not only promotes financial performance but also bolsters non-financial outcomes, including organizational commitment and individual performance (Park et al., 2021).

4.2. Digital Leadership and Job Satisfaction: Empirical Evidence

The relationship between digital leadership and job satisfaction has been extensively studied across industries and regions. Research consistently demonstrates that digital leaders positively influence employee satisfaction by fostering supportive, innovative, and efficient workplace environments. For instance, Abbasov and Tolay (2021) and Artüz (2020) found that digital leadership enhances employee performance and satisfaction, particularly in organizations undergoing digital transformation. These leaders enable employees to achieve goals more effectively by reducing inefficiencies and creating collaborative, technology-driven environments.

Benitez et al. (2022) examined the impact of digital leadership on organizational innovation, finding that leaders who leverage digital platforms significantly enhance their firms' innovation capacity. Their study underscores the importance of digital leadership in fostering creativity, which, in turn, contributes to job satisfaction. Yusuf et al. (2023) provided further evidence of the positive relationship between digital leadership and employee performance. Their analysis revealed that effective digital leaders not only improve individual productivity but also create conditions that enhance employees' overall workplace experience.

4.3. Digital Leadership in Sector-Specific Contexts

Numerous studies highlight the transformative impact of digital leadership across various sectors.

Alfares and Banikhaled (2022) investigated the role of digital leadership in the healthcare industry, reporting significant improvements in employee performance and satisfaction. Similarly, Erhan et al. (2022) explored the textile industry in Turkey, concluding that digital leadership fosters innovative behaviors among employees, which contribute to higher satisfaction levels.

In public administration, Hanandeh et al. (2023) demonstrated the positive effects of digital leadership on business process performance and entrepreneurial motivation. Their findings emphasize the versatility of digital leadership in enhancing organizational outcomes, regardless of sectoral differences.

The education sector has also benefited from digital leadership. Srimata et al. (2019) found that school administrators practicing digital leadership positively influenced the school climate, leading to higher teacher engagement and satisfaction. Similarly, Tanucan et al. (2022) reported a strong correlation between digital leadership and job satisfaction among teachers, underscoring its relevance in fostering supportive and innovative educational environments.

4.4 Enhancing Job Satisfaction Through Digital Leadership

Digital leadership enhances job satisfaction by addressing key employee needs: efficient task management, opportunities for growth, and a positive work environment. Leaders who leverage digital tools and strategies enable employees to complete tasks with greater accuracy, reduced stress, and higher productivity. These outcomes contribute significantly to overall job satisfaction (Altınöz, 2008).

Research also highlights the role of digital leadership in fostering intrinsic motivation. Azzam et al. (2022) found that digital leaders positively influence employees' well-being, motivation, and performance, creating environments where individuals feel valued and engaged. Similarly, Sulistina and Darma (2023) reported that digital leadership enhances satisfaction by promoting collaboration, innovation, and adaptability.

In a study conducted by Antonopoulou et al. (2021), it was demonstrated that the highest levels of productivity and satisfaction are achieved when digital leadership is fully implemented. Topcuoglu et al. (2023) further emphasized the holistic impact of digital leadership. Their study revealed that employees under digital leaders not only experience greater job satisfaction but also report higher life satisfaction, illustrating the far-reaching effects of this leadership style.

4.5 Challenges and Opportunities in Digital Leadership

Despite its numerous benefits, digital leadership is not without challenges. Leaders must navigate rapid technological changes, address resistance to innovation, and ensure equitable access to digital tools and training. Effective digital leaders overcome these challenges by fostering a culture of inclusivity and continuous learning, ensuring that employees at all levels feel supported during the transformation process.

Kamaruddin et al. (2024) underscore the importance of leadership agility in addressing these challenges. Their study revealed that leaders who prioritize adaptability, transparency, and ethical decision-making foster higher levels of employee satisfaction and engagement, even in rapidly changing environments.

While existing research highlights the positive impact of digital leadership, further exploration is needed to understand its intersection with emerging trends such as artificial intelligence, remote work, and cross-cultural collaboration. Longitudinal studies could provide deeper insights into how digital leadership evolves over time and its sustained impact on employee outcomes.

Future research should also explore the mediating and moderating factors that influence the relationship between digital leadership and job satisfaction. Variables such as organizational culture, employee demographics, and industry-specific factors may shape the effectiveness of digital leadership practices.

5. CONCLUSION

This study underscores the critical role of digital leadership in enhancing job satisfaction within the context of digital transformation. By synthesizing theoretical insights and empirical evidence, it demonstrates that digital leaders, through their ability to align technological innovation with human-centric approaches, foster environments conducive to employee well-being and organizational success.

The importance of this subject cannot be overstated, particularly as organizations worldwide undergo profound changes driven by the rapid pace of technological advancement. In an era where digital tools and automation increasingly shape work environments, understanding how leadership adapts to and harnesses these technologies is paramount. Digital leadership emerges as a linchpin in navigating these complexities, serving as a bridge between technological imperatives and human needs. Leaders adept at integrating innovation with empathy not only ensure smoother transitions during digital transformation but also cultivate workplace cultures that prioritize employee satisfaction and retention.

A key takeaway is the multifaceted impact of digital leadership on employee satisfaction. Leaders who prioritize transparency, inclusivity, and skill development create a culture of trust and empowerment. These qualities are particularly significant in addressing challenges such as resistance to change and technological apprehension. Employees are more likely to embrace digital transformation when they feel supported and valued, reducing turnover and fostering long-term loyalty. By proactively addressing these challenges, digital leaders serve as catalysts for sustaining employee motivation and productivity in rapidly evolving workplaces.

This study is also significant because it brings much-needed attention to the interplay between leadership and digital transformation. Organizations are increasingly recognizing that technological upgrades alone cannot drive success; leadership that inspires and motivates employees is equally critical. Highlighting the strategies and behaviors of effective

digital leaders provides organizations with actionable insights to enhance both individual and organizational performance.

However, the study also highlights several gaps in the existing literature, which present exciting opportunities for further research. For instance, while the influence of digital leadership on job satisfaction is evident, the mediating roles of organizational culture, employee digital literacy, and technological infrastructure remain underexplored. These variables could significantly shape how digital leadership is perceived and its overall effectiveness. Additionally, longitudinal studies examining causal relationships are essential to understand the enduring impact of digital leadership on job satisfaction, particularly as organizations move from initial digital adoption phases to more advanced stages of digital maturity.

Another promising avenue for further exploration is the intersection of digital leadership with diversity, equity, and inclusion (DEI) initiatives. As workplaces become more diverse, understanding how digital leaders can create equitable and inclusive environments will be critical for fostering holistic organizational growth. This includes examining how leaders can leverage technology to address inequities, promote inclusive decision-making, and ensure equal access to digital resources and opportunities.

From a practical perspective, organizations must invest in developing digital leadership competencies. This involves not only technical training but also fostering soft skills such as empathy, adaptability, and collaboration. Leadership development programs should emphasize the importance of balancing technological expertise with human connection, enabling leaders to inspire trust and drive meaningful change. Furthermore, organizations should consider integrating digital leadership principles into their overall strategic frameworks to ensure alignment with long-term goals.

The implications of digital leadership extend beyond individual organizations, influencing broader societal and economic outcomes. By equipping leaders with the skills needed to navigate digital

transformation effectively, societies can better address challenges such as the digital divide, workplace automation, and shifts in labor market dynamics. Future research should therefore consider the macro-level implications of digital leadership, exploring its role in shaping sustainable and inclusive growth.

In conclusion, digital leadership represents a transformative force in modern organizations, bridging the gap between technological advancement and employee satisfaction. Its relevance will only grow as workplaces continue to evolve, characterized by new technologies, diverse workforces, and complex global challenges. The ability of leaders to adapt, inspire, and innovate will be the defining factor in achieving long-term organizational excellence. Future research should continue to explore this dynamic field, offering innovative strategies to enhance both leadership practices and employee experiences. By doing so, scholars and practitioners alike can contribute to building workplaces that are not only technologically advanced but also deeply human-centric, ensuring a harmonious and productive future for all stakeholders.

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UNVEILING RESEARCH PATTERNS IN CARBON ACCOUNTING: A BIBLIOMETRIC STUDY OF GRADUATE THESES IN TÜRKİYE

Ayşe Gül GÖK*

* Lecturer Dr., Alanya Alaaddin Keykubat University, Department of Business Administration, ayse.gok@alanya.edu.tr, <https://orcid.org/0000-0003-3263-1213>.

ABSTRACT

Environmental issues such as global warming and climate change have heightened the importance of monitoring and reporting environmental performance and sustainability levels of businesses. As a result, environmental accounting has emerged as a critical tool for calculating and reporting carbon costs. Carbon accounting, a specialized branch of environmental accounting, helps businesses track, report, and reduce their carbon footprints. In the context of combating climate change, carbon accounting supports sustainability goals and helps companies comply with regulations that influence financial performance. This study uses bibliometric methods to analyze graduate theses on carbon accounting available in the Council of Higher Education (YÖK) database, focusing on terms such as carbon pricing and carbon accounting. A total of 15 theses were examined based on parameters including publication years, research methods, and keywords. Findings indicate that graduate research on carbon accounting started in 2014, with significant growth in 2022. The five most frequently used keywords were carbon, accounting, carbon accounting, sustainability and emissions. The majority of studies were conducted in the business administration field using quantitative methods. This research highlights trends and gaps in the literature, offering insights for future academic and practical work on carbon accounting.

Keywords: Accounting, Carbon Accounting, Bibliometric Analysis, Sustainability, Environmental Performance.

1. INTRODUCTION

Environmental degradation has become one of the most pressing challenges of the modern era, prompting an increasing global awareness of the need to reduce human impacts on the planet. As a result, businesses are under growing pressure to adopt strategies that minimize their environmental footprints and contribute to sustainability efforts (Çakıraslan & Öztürk, 2024). One such strategy is environmental accounting, which involves incorporating environmental data into the financial reporting systems of organizations. Environmental accounting is essential in measuring and managing the costs incurred by businesses to protect ecosystems and mitigate negative environmental impacts (Jasch, 2003). These costs, referred to as environmental costs, include expenditures related to pollution control, waste management, resource conservation, and sustainable practices (Kücüker, 2017). By providing a systematic approach to tracking environmental expenses, environmental

accounting allows businesses to assess the financial implications of their environmental activities, helping them align their operations with sustainability goals (Yakhou & Dorweiler, 2004).

A critical component of environmental accounting is carbon accounting, which specifically focuses on the measurement and reporting of greenhouse gas (GHG) emissions in terms of carbon dioxide equivalents. With the growing urgency to combat climate change, carbon accounting has become a vital tool for businesses to evaluate their carbon footprints and take steps to mitigate their environmental impacts (Schaltegger & Csutora, 2012). This specialized form of accounting enables businesses to align their operations with international climate agreements such as the Kyoto Protocol and the Paris Agreement (Tang, 2017). Through transparent reporting of carbon emissions, businesses can track their progress toward sustainability goals, ensure compliance with environmental regulations, and communicate their

environmental performance to stakeholders (Tang & Demeritt, 2018).

In Türkiye, the academic interest in environmental accounting began in the 1990s as the country recognized the importance of integrating environmental considerations into business practices (Kaya & Akdeniz, 2016). The evolution of carbon accounting in Türkiye has followed global trends, gaining increasing attention in recent years as part of broader efforts to address climate change and sustainability challenges. Despite this growing interest, there remains limited research on the specific applications and challenges of carbon accounting in the Turkish context, highlighting the need for further academic exploration (Altınbay & Durak, 2022).

This study aims to address this gap by analyzing graduate theses on carbon accounting available in the YÖK Thesis Database. Through a bibliometric analysis, this research seeks to identify emerging trends, research methodologies, and potential gaps in the field of carbon accounting in Türkiye. The study's focus is to provide a comprehensive overview of the academic landscape of carbon accounting, offering insights into the evolution of the field, key thematic areas of interest, and the methodological approaches employed in existing research. By examining these trends, this paper also aims to highlight areas where future research could contribute to the development of more effective and regionally adapted carbon accounting practices.

Bibliometric analysis, as a research tool, offers a systematic method for evaluating the structure and dynamics of academic research. It allows researchers to analyze patterns of publication, identify key themes and topics, and assess the impact of various studies within a specific field. In this study, bibliometric analysis will provide valuable insights into the growth and development of carbon accounting research in Türkiye, shedding light on the methodological and thematic shifts that have taken place over time.

The paper is structured as follows: the first section provides an overview of bibliometric analysis as a tool for research, discussing its advantages and

applications in assessing trends and methodologies within academic literature. The second section presents the findings of the bibliometric analysis, focusing on the key trends, thematic areas, and research methodologies identified in the selected graduate theses. Finally, the paper concludes with a discussion of the implications of these findings for both academia and practice, highlighting the areas that require further investigation and offering recommendations for future research on carbon accounting in Türkiye.

2. CONCEPTUAL FRAMEWORK

Bibliometric analysis is a quantitative research methodology that employs mathematical and statistical techniques to examine the development, structure, and trends within academic disciplines (Zupic & Čater, 2015). First introduced by Alan Pritchard in 1969, the term "bibliometrics" pertains to the application of these methods to written communication, providing valuable insights into the state and progress of scientific domains (Lawani, 1981). Through bibliometric methods, researchers can analyze various parameters such as publication volume, citation networks, authorship patterns, and keyword frequencies, offering a comprehensive view of the academic landscape within a given field. These analyses enable scholars to track the evolution of academic knowledge, identify influential works, detect emerging themes, and uncover gaps in the literature. Moreover, bibliometric studies can help forecast future research directions by revealing patterns that might otherwise be difficult to discern (Lim & Kumar, 2024).

In the context of accounting, bibliometric methods have been widely applied to a variety of research topics, such as financial performance, digital transformation, and independent auditing. These studies play a pivotal role in identifying influential publications, understanding the trajectory of the field, and mapping key areas of interest. For example, Hotamışlı & Erem (2014) utilized bibliometric analysis to explore the academic output in accounting and finance journals, uncovering a focus on financial markets, public economics, and capital markets. Their study highlighted the concentration

of research within certain subfields and the publication trends over time.

The objective of the Katanalp (2024) study was to employ bibliometric techniques for the analysis of the status of scientific works by academics in Turkey, as identified in international databases. The study revealed that research on accounting education and professionals is continually evolving, with recent contributions emphasizing the field of accounting history.

In a recent study, Kaya (2024) analyzed papers published in the *Journal of Accounting and Auditing Perspectives* from 2017 to 2023 using bibliometric techniques. The research findings indicated that the articles in the journal predominantly addressed accounting standards, accounting professionals, and accounting education and independent auditing.

In a similar vein, Gök (2024) conducted a bibliometric analysis of theses on digitalization in accounting, revealing shifting trends, methodological preferences, and the increasing prominence of digital technologies within the discipline. This analysis contributed to a deeper understanding of how accounting is adapting to technological advancements and how these changes are reflected in academic research.

Carbon accounting, which is a specialized subset of environmental accounting, has gained considerable attention in recent years due to growing global concerns about climate change and environmental sustainability. Carbon accounting focuses specifically on tracking, measuring, and reporting greenhouse gas emissions, thereby helping businesses and organizations assess their environmental impact and reduce their carbon footprint (Schaltegger & Csutora, (2012). This field intersects multiple disciplines, including sustainability, economics, environmental policy, and regulatory compliance. As such, bibliometric analysis of carbon accounting allows for the exploration of its academic development, identification of key research themes, and the evaluation of its alignment with broader environmental goals (Stechemesser & Guenther, 2012).

Environmental accounting, the precursor to carbon accounting, emerged in the early 1970s as businesses and governments began to recognize the importance of environmental data in decision-making processes (Ding et al., 2014). The incorporation of environmental considerations into corporate financial reporting was influenced by international environmental agreements such as the Kyoto Protocol, the Basel Convention, and the Paris Agreement (Prieto, 2020). These agreements imposed stricter obligations on countries and corporations to reduce emissions and improve sustainability reporting. In Türkiye, environmental accounting research began gaining traction in the 1990s, providing a foundation for studies on carbon accounting in the subsequent decades. The early focus of these studies was on integrating environmental costs into financial reporting frameworks, thus creating an accounting mechanism for firms to evaluate their ecological impact (Çelik, 2018).

Building on environmental accounting principles, carbon accounting focuses specifically on the measurement, reporting, and reduction of greenhouse gas emissions. As corporations and governments recognized the urgent need to mitigate climate change, carbon accounting practices became a crucial tool for assessing and managing carbon liabilities. Studies such as Samaduzzaman et al. (2013) underscore the role of carbon accounting in promoting sustainability by helping organizations develop strategies to reduce their environmental footprint. Additionally, Tang (2017) provides a comprehensive framework for integrating carbon management within corporate structures, offering a blueprint for businesses to adopt carbon accounting practices.

Bibliometric analysis in carbon accounting is particularly valuable because it enables scholars to gain insights into the field's evolution over time, identify influential studies, and trace the impact of regulatory and technological advancements on research trends (Zheng, 2022). Parameters such as keyword frequencies, publication years, citation patterns, and authorship networks can help map the development of carbon accounting and identify

dominant themes, including the role of policy in shaping the field. Furthermore, bibliometric analyses can reveal emerging areas of research, such as the use of blockchain for carbon tracking or the integration of carbon accounting within broader corporate sustainability strategies.

The application of bibliometric methods in carbon accounting research can also shed light on interdisciplinary trends, as the field encompasses elements from accounting, environmental science, economics, and public policy. For instance, bibliometric analyses could uncover the increasing role of sustainability frameworks, such as the Global Reporting Initiative (GRI) or the Task Force on Climate-related Financial Disclosures (TCFD), in shaping carbon accounting practices. Additionally, by examining authorship patterns, citation networks, and thematic clusters, researchers can identify key collaborations between scholars from different disciplines and regions, offering insights into the globalization of carbon accounting research.

In this study, bibliometric analysis will serve as a tool to explore the key trends, emerging topics, and major influences in the field of carbon accounting. By examining factors such as publication volume, citation networks, and thematic focus, this research will contribute to a deeper understanding of how carbon accounting has evolved, its current state, and potential future directions. Furthermore, it will highlight critical gaps in the literature, providing guidance for future research efforts and offering recommendations for practitioners and policymakers seeking to improve their carbon accounting practices.

3. METHODOLOGY

The study analyzed 15 postgraduate theses from the YÖK Thesis Database. The selection criteria included theses containing the terms “carbon accounting” or “carbon pricing” in their titles or abstracts. The bibliometric analysis was conducted based on parameters such as:

- Languages of the theses
- Distribution of keywords
- Gender of authors

- Research methods
- Departments and institutes
- Universities and geographic distribution

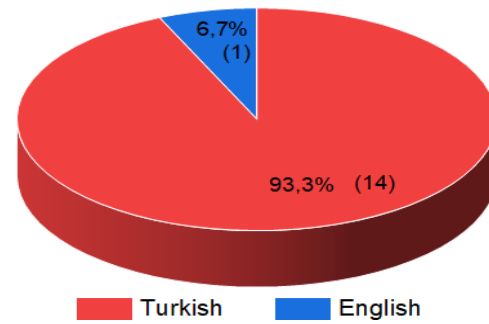
Data were analyzed using descriptive statistics and content analysis. Ethical standards were maintained throughout, ensuring transparency and accuracy in reporting.

4. FINDINGS

Language

Of the theses analyzed, 14 were written in Turkish, and only one in English (Figure 1). This demonstrates a clear preference for the Turkish language in academic research within this context. The scarcity of English theses may limit international visibility and collaboration, suggesting an opportunity to encourage bilingual research outputs.

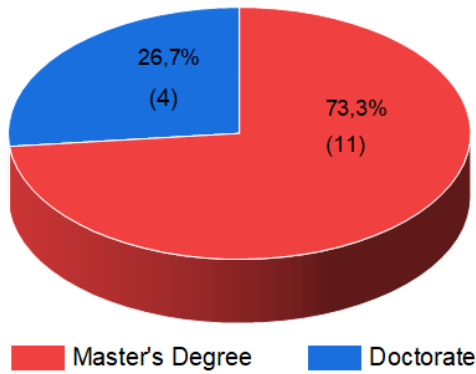
Figure 1. Languages of the Examined Theses



Graduate Level

As seen in Figure 2, among the theses, 73.3% were master's theses, and 26.7% were doctoral dissertations. This reflects a higher emphasis on graduate-level research at the master's level, potentially because it is more accessible or aligns with the academic demands of the field. The lower number of doctoral studies may highlight the need for more advanced research to deepen expertise.

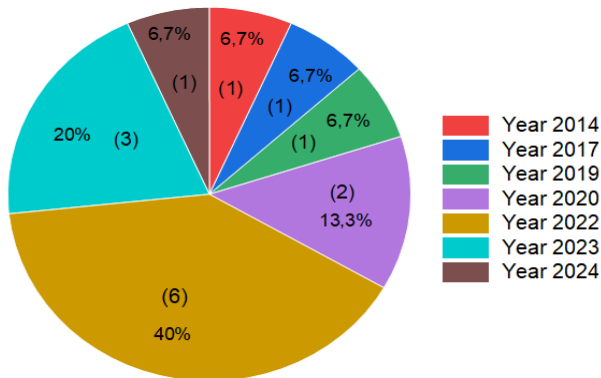
Figure 2. Graduate Levels of the Examined Theses



Publication Year

Figure 3 depicts that the theses were published between 2014 and 2024, with the majority (60%) appearing in 2022 and 2023. This clustering indicates growing interest or activity in recent years, possibly due to evolving academic priorities, emerging research areas, or funding incentives.

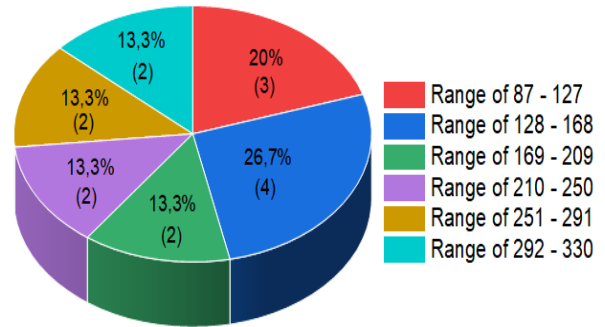
Figure 3. Publication Years of the Examined Theses



Page Range

As seen in Figure 4, the theses varied significantly in length, with the largest proportion (26.7%) falling within 128–168 pages. The spread across other page ranges shows diversity in research scope and depth. The variation might be attributed to the complexity of topics or differing institutional guidelines.

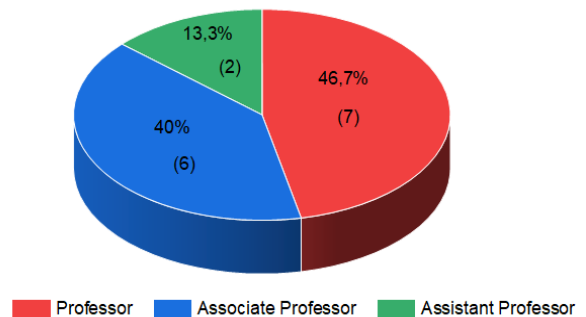
Figure 4. Number of Pages of the Examined Theses



Academic Titles of the Supervisors

The academic titles of the supervisors are as follows (Figure 5): 46.7% of the theses were supervised by Professors, 40% by Associate Professors, and 13.3% by Assistant Professors. This distribution indicates that experienced faculty members are primarily responsible for guiding graduate research, which reflects the crucial role of expertise in ensuring the quality and rigour of academic work.

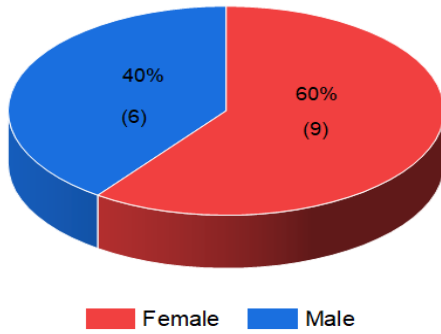
Figure 5. Academic Titles of the Supervisors of the Examined Theses



Gender

With regard to gender, the authors included 60% female and 40% male researchers (Figure 6). The higher proportion of female authors may be indicative of evolving dynamics in gender representation within the academic realm, potentially influenced by an increase in inclusion or support initiatives.

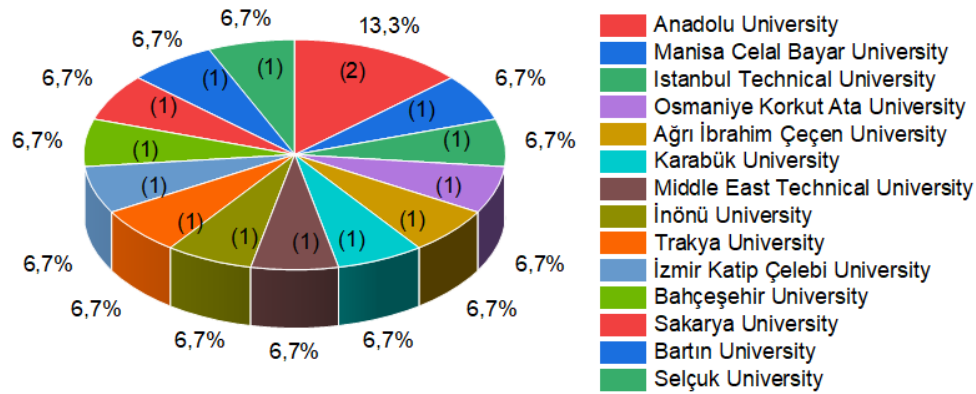
Figure 6. Genders of the Researchers



Universities

As seen in Figure 7, Anadolu University accounted for the highest number of theses (2), while other universities contributed one thesis each. Geographically, the Central Anatolia Region led with 4 theses, followed by the Marmara, Aegean, Black Sea, and Eastern Anatolia Regions, each contributing 2 theses, and the Mediterranean Region contributing 1. This uneven distribution may reflect regional variations in research infrastructure, focus, or opportunities.

Figure 7. Universities Where the Theses Submitted



The regional distribution of the universities where

the examined theses were accepted is presented in Figure 8.

Figure 8. Locations the Universities that the Examined Theses Submitted



Types of Graduate Schools

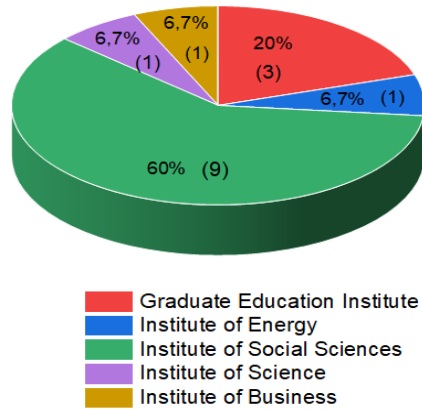
The distribution of theses by type of graduate school is as follows (Figure 9): 60% were hosted by the Institute of Social Sciences, 20% by the Institute of Graduate Education, and smaller contributions from

the Energy Institute (6.7%), the Institute of Science (6.7%), and the Institute of Business (6.7%). This suggests that the social sciences represent the dominant field of graduate research within the

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dataset, with specialised areas of study contributing less frequently.

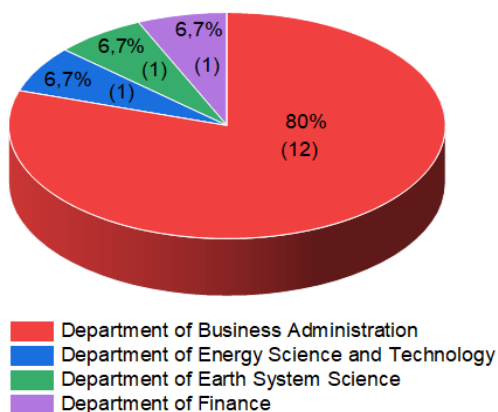
Figure 9. Graduate Schools of the Examined Theses Submitted



Major Disciplines

As highlighted in Figure 10, the majority of theses were within the field of business administration, which accounted for 80% of the total. This highlights the central role that this discipline plays in the research. The remaining disciplines accounted for a minor share (6.7% each), indicating a necessity to diversify research across disciplines in order to facilitate broader academic exploration.

Figure 10. Major Disciplines of the Examined Theses

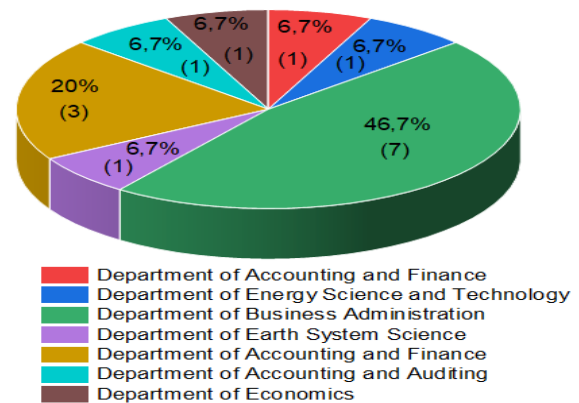


Scientific Fields

The results of the evaluation of the 15 theses revealed that 46.7% were accepted in the field of Business Administration, while 20% were accepted in the field of Accounting and Finance (Figure 11). The

remaining fields contributed 6.7% each. The preponderance of business-related subjects indicates the primacy of these disciplines within the context of the study, suggesting a robust alignment with contemporary economic and managerial challenges.

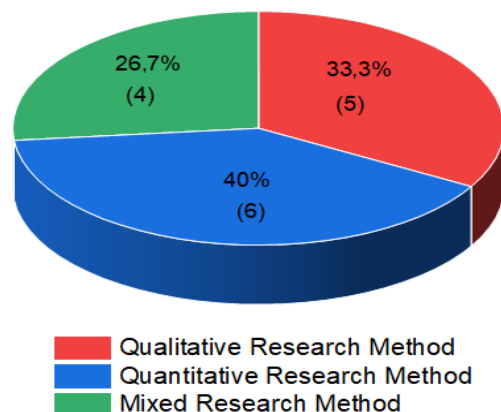
Figure 11. Scientific Fields of the Examined Theses



Research Methods

Figure 12 demonstrates that the most frequently employed research methods were quantitative (40%), followed by qualitative (33.3%) and mixed methods (26.7%). The preference for quantitative approaches indicates a focus on measurable, data-driven insights, while the notable use of qualitative and mixed methods suggests an interest in exploring nuanced, multifaceted phenomena.

Figure 12. Research Methods of the Examined Theses



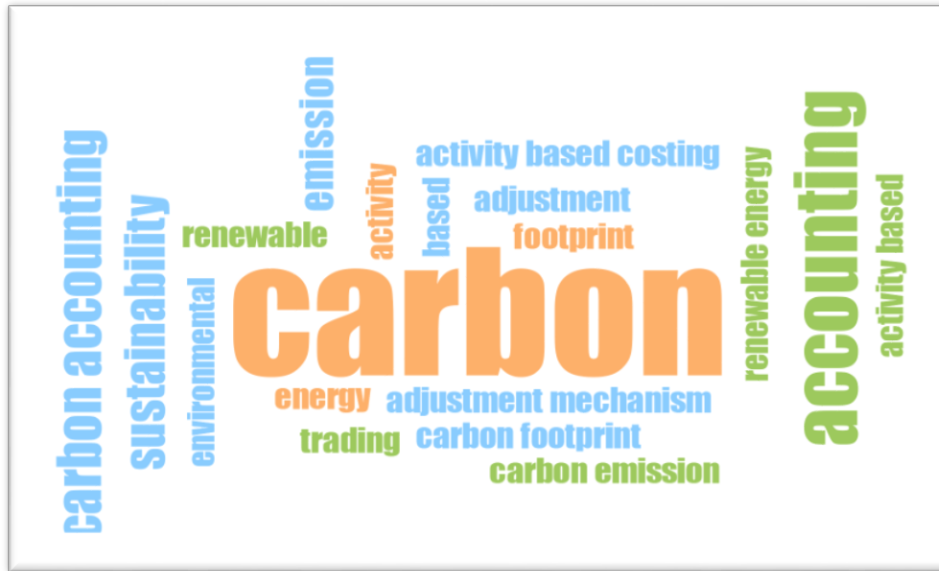
Keywords

The keyword analysis in Figure 13 revealed "carbon" as the most frequent term (25 repetitions), followed

by "accounting" (15), "carbon accounting" (11), "sustainability" (10), and "emissions" (7). This pattern highlights a strong focus on environmental and

sustainability issues, particularly carbon-related topics, reflecting their increasing importance in contemporary research and policy discussions.

Figure 13. Keywords of the Examined Theses



Key Findings of the Theses

Aliusta (2014) investigated the influence of national and international economic measures targeting emission reductions on businesses' accounting and financial frameworks. The study concluded that controlling carbon costs is crucial for sustainable growth. It emphasized that a well-designed accounting system, which integrates carbon expenses, is indispensable for businesses to achieve this goal. This underscores the importance of adapting financial structures to address environmental objectives.

Küçüker (2017) analyzed the significant impact of business practices on energy consumption and carbon emissions. The findings revealed that a substantial portion of carbon emissions originates from natural gas consumption, highlighting the importance of energy-efficient strategies. This study provides critical insights into identifying and addressing major sources of carbon footprints in business operations.

Kara (2020) explored the accounting and reporting of carbon emission certificates under international accounting standards. Using a practical example, the

study demonstrated the application of both cost and revaluation methods. This contribution is pivotal for enhancing transparency and consistency in reporting emission-related financial data.

Halaç (2020) evaluated a textile company's renewable energy investments and carbon emission credits. By presenting best practices for accounting in these areas, the study offered a financial perspective on integrating sustainability initiatives into business strategies, serving as a benchmark for other industries.

Kılıç (2022) conducted a historical analysis of Türkiye's progress in the green economy. The study concluded that environmental taxes implemented as policy tools have not fully achieved their objectives. This finding calls for a reassessment of policy effectiveness and the potential for more innovative green economy strategies.

Ünsal (2023) examined Türkiye's environmental policies and the role of carbon tax applications. The study highlighted the inefficiency of existing environmental taxes and emphasized the need for carbon pricing tools aligned with sustainable development goals. This work is a call to action for

policy reform aimed at achieving measurable environmental and economic benefits.

Şimşek (2019) focused on a thermal power plant's efforts to reduce carbon emissions. Through accounting records based on real data, the study demonstrated practical measures that businesses can adopt to minimize their environmental impact while ensuring compliance with environmental regulations.

Ulucenk (2022) proposed an alternative carbon accounting model for the maritime transport sector within the sustainability framework. This study broadens the scope of carbon accounting by addressing the unique challenges and opportunities in maritime operations.

Kılınç (2022) analyzed the impact of the Carbon Border Adjustment Mechanism (CBAM) on Türkiye's steel and cement sectors. The study concluded that carbon costs significantly reduce exports, GDP, and overall output, highlighting the economic challenges of adapting to international carbon regulations.

Ok (2022) provided a detailed cost comparison of products in a company using both traditional and activity-based costing systems. By illustrating the share of production costs linked to carbon emissions, this study highlighted the need for businesses to adopt more accurate and environmentally conscious costing methods.

Ergün (2022) demonstrated the growing significance of carbon costs as a business expense through an example application using developed software. The study highlighted the operational adjustments required for companies to manage these rising costs effectively.

İbaçoğlu (2023) conducted a bibliometric analysis and found the USA and China leading in carbon accounting publications, with Türkiye ranking 25th. This study emphasized the need for increased academic contributions from Türkiye to elevate its position in global research.

Altay (2022) calculated the carbon footprint of a steel company using emission-causing input data. The study suggested that renewable energy sources could significantly enhance energy management,

providing actionable recommendations for companies in heavy industries.

Şutaşdemir (2023) compared the emission trading system with carbon taxes in Türkiye, concluding that the trading system offers greater benefits in reducing the economic burden of emissions and the CBAM. This study contributes to the ongoing debate on the effectiveness of different carbon reduction mechanisms.

Tüjümet (2024) focused on developing a carbon accounting application for a chemical company. This practical tool demonstrates how businesses can financially approach carbon reduction projects and align them with accounting standards, paving the way for innovative solutions in this area.

A common theme across these studies is the critical role of carbon accounting in aligning business operations with sustainability goals. Most studies emphasized the financial implications of carbon costs, highlighting the necessity of integrating sustainability into accounting frameworks. For instance, Aliusta (2014) and Kara (2020) focused on foundational accounting practices, while studies like Küçük (2017) and Altay (2022) addressed sector-specific challenges. Meanwhile, policy-focused studies such as Kılınç (2022) and Ünsal (2023) provided insights into the broader economic and regulatory landscape.

Sectoral diversity in the studies—ranging from steel and textile industries to maritime transport—demonstrates the multifaceted challenges and solutions in carbon accounting. Furthermore, the emphasis on policy mechanisms, such as the CBAM and carbon taxes, highlights the intersection of accounting practices with international regulations.

Overall, while the studies collectively stress the need for robust carbon accounting frameworks, they also reveal gaps in policy effectiveness and international competitiveness, particularly in Türkiye. Bridging these gaps will require coordinated efforts among policymakers, businesses, and academic researchers to develop innovative tools and frameworks that align with global standards.

5. CONCLUSION

This study provides valuable insights into the evolution of carbon accounting research in Türkiye, highlighting its increasing significance as a tool for addressing climate change and achieving sustainability goals. As nations strive to meet their international climate commitments, carbon accounting is emerging as a key practice in tracking and reducing carbon emissions, helping both businesses and governments meet the mandates set by international frameworks such as the Paris Agreement. Through a bibliometric analysis of 15 graduate theses, this study uncovers the trends in the research methods, thematic focuses, and geographical scope of carbon accounting studies in Türkiye, contributing to the growing body of literature on the subject.

The findings reveal significant growth in carbon accounting research, particularly in response to regulatory pressures and sustainability objectives. The uptick in studies during 2022 aligns with global momentum around climate agreements and national policies advocating for stricter emissions reporting. This highlights a growing recognition of the importance of carbon accounting in driving effective climate action.

Carbon accounting, as a rapidly evolving field, plays an essential role in managing greenhouse gas emissions and ensuring that businesses, governments, and other stakeholders are transparent and accountable in their sustainability efforts. In line with global calls for more rigorous carbon reporting, the Turkish context shows an increasing focus on emissions reduction, sustainability, and regulatory compliance. This alignment with global climate goals reflects a growing recognition of the importance of carbon accounting in driving effective climate action. While much of the focus has been on global strategies, this study places emphasis on the regional and national dimensions, offering new insights into the Turkish research landscape.

From a methodological perspective, the predominance of quantitative methods underscores the field's reliance on empirical and financial data, reflecting its technical and regulatory orientation.

However, the limited use of qualitative and mixed methods suggests an opportunity to explore more nuanced, contextual analyses of how organizations implement carbon accounting. For example, qualitative studies could examine decision-making processes behind adopting carbon management tools or the cultural shifts required within organizations. Expanding the range of methodologies will enrich the field and offer a more comprehensive understanding of carbon accounting practices.

The bibliometric analysis reveals several key trends that are of particular importance for both academia and practice. First, the thematic trends indicate that regulatory compliance, sustainability, and emissions reduction are central concerns in the research on carbon accounting. These themes mirror the priorities of global environmental policies that focus on emission reductions, such as the Kyoto Protocol and the more recent Paris Agreement.

Regulatory compliance in the context of carbon accounting refers to the adherence to national and international climate policies that require entities to report and reduce their carbon emissions. Research on this topic is vital for ensuring that carbon accounting practices align with evolving legislation and help organizations track their contributions to climate goals. The research also reveals that the regulatory environment in Türkiye is becoming more supportive of carbon accounting as a tool for emissions tracking, which may prompt future studies to explore the implications of specific policies on carbon practices in Turkish industries.

Thematic trends identified in this study reveal a focus on regulatory compliance, sustainability, and emissions reduction, aligning closely with global climate priorities. The dominance of keywords such as "carbon," "accounting," and "sustainability" reflects the alignment of research with international climate goals. However, the underrepresentation of advanced topics like digital carbon tracking and blockchain integration indicates potential research gaps. Exploring these emerging technologies could enhance transparency, precision, and efficiency in emissions reporting and tracking.

A significant finding of this study is the identification of emerging sectoral applications, such as renewable energy investments and industry-specific carbon tracking. Carbon accounting is not just a universal framework but also one that requires sector-specific adaptation. Renewable energy investments are a key component of Türkiye's national climate strategies, as the country has been actively pursuing goals to transition to a more sustainable energy mix.

The integration of renewable energy sources such as wind, solar, and hydropower into the national grid has profound implications for carbon accounting systems, as these investments impact emissions profiles and carbon offset strategies. By incorporating renewable energy projects into carbon accounting systems, organizations can better track the reductions in carbon emissions and the potential for achieving net-zero emissions. Further research could delve deeper into the effectiveness of carbon accounting in assessing the true environmental impact of renewable energy projects and whether current methodologies are equipped to handle this.

Sector-specific findings demonstrate that carbon accounting research has begun addressing industry-specific challenges, such as those faced by the textiles and steel sectors. These findings highlight opportunities for cross-sectoral comparisons to identify best practices and innovative solutions. For instance, renewable energy investments in industries can significantly influence carbon profiles and sustainability strategies. Future research should delve deeper into the effectiveness of carbon accounting in assessing the environmental impact of renewable energy projects and addressing the unique needs of carbon-intensive sectors.

The bibliometric analysis also reveals that sector-specific applications involve industry-specific carbon tracking, which is becoming increasingly important as companies and governments seek tailored solutions to their unique challenges in achieving sustainability. Industries such as manufacturing, transportation, and agriculture are particularly carbon-intensive and therefore require specialized approaches to effectively measure and mitigate emissions. The existing body of literature

highlights that the carbon accounting methods in these industries have significant room for development, particularly in terms of methodological integration and accuracy in emissions reporting (Cames et al., 2016). The research in Türkiye, while still nascent, is pointing toward a growing interest in developing such specialized tools that can accommodate the diverse needs of these sectors.

The geographical concentration of carbon accounting research in certain regions of Türkiye, as highlighted by this study, points to a need for a broader exploration of the institutional and economic contexts across the country. While large urban centers, such as Istanbul and Ankara, have been the focal points of academic research, other regions with varying economic structures and environmental conditions could offer valuable insights into the diverse challenges and opportunities in carbon accounting.

Regional disparities in economic development, industrial activity, and environmental vulnerability make it important to consider the diversity of contexts when developing carbon accounting systems. A more inclusive approach to research, which examines rural and less economically developed areas, would not only enrich the academic discourse but also ensure that the practices of carbon accounting are accessible and applicable across different socio-economic settings.

In terms of future research directions, there is considerable potential for expanding the scope of carbon accounting studies to incorporate global perspectives, as well as cross-cultural comparisons. The expanding body of literature on global carbon accounting practices highlights the importance of adapting accounting systems to regional variations in climate policies, industrial practices, and societal needs (Pereira et al., 2021).

Expanding the linguistic and geographic diversity of research in Türkiye would allow for richer discussions and contribute to the broader global dialogue on climate action. It is important for scholars in Türkiye to not only examine domestic practices but also engage with international research

to understand best practices, the challenges faced in other contexts, and innovative solutions that could be adapted to the Turkish context.

In conclusion, this bibliometric study on carbon accounting research in Türkiye offers valuable insights into the field's development and highlights several key trends and opportunities for future research. Policymakers, educators, and industry leaders can leverage these insights to promote innovative practices and further advance the sustainability agenda. As the field of carbon accounting evolves, it is critical for researchers to explore new methodologies, integrate interdisciplinary approaches, and expand the geographical and sectoral scope of their studies. By doing so, they can help advance carbon management strategies that are both effective and adaptable to the dynamic challenges posed by climate change.

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A BIBLIOMETRIC ANALYSIS OF THE THESES ON INTERNAL AUDIT AND INTERNAL CONTROL IN TÜRKİYE

Sevim AĞAÇ*

* Dr., sevimagac07@gmail.com, <https://orcid.org/0000-0002-8144-4927>.

ABSTRACT

Internal audit and internal control are fundamental to ensuring the efficiency, accountability, and sustainability of organizations, especially in the context of growing complexities in global business environments. These mechanisms play a pivotal role in risk management, compliance, and the achievement of organizational objectives, making them indispensable for modern governance and performance enhancement. Despite their importance, academic research combining these topics remains underexplored in Türkiye. This study undertakes a bibliometric analysis of graduate theses addressing internal audit and internal control in Türkiye, as indexed by the National Thesis Center of the Council of Higher Education. The analysis evaluates key parameters, including thesis type, language, year of publication, university affiliation, research methods, and study focus. The findings reveal that most theses were master's level, written in Turkish, and primarily conducted at public universities, with a notable concentration in business administration. Quantitative methods were the most commonly employed research approach. This study underscores the limited academic focus on integrating internal audit and internal control, despite their growing relevance in contemporary organizational contexts. By mapping existing academic contributions, it provides a valuable reference for future studies, offering insights into trends and highlighting the need for expanded scholarly attention in this critical area of accounting and governance.

Keywords: *Internal Audit, Internal Control, Bibliometric Analysis, Accounting Research.*

1. INTRODUCTION

Businesses and organizations operate in environments defined by increasingly complex and dynamic challenges. As they strive to achieve their strategic goals, compliance with established rules, regulations, and principles becomes imperative (Nadler & Tushman, 1999). The audit function, whether driven by internal demands or legal requirements, plays a pivotal role in evaluating adherence to these frameworks, assessing progress toward objectives, and identifying disruptions or deficiencies (Usul, 2023). Consequently, audits serve as a cornerstone for ensuring operational continuity and providing a mechanism for organizational improvement. Among the various forms of auditing, internal audit and internal control stand out as critical mechanisms for enhancing the effectiveness, accountability, and sustainability of organizations (Savčuk, 2007).

The concepts of internal audit and internal control have evolved considerably, adapting to the demands of modern organizations and globalized markets. Internal control is often described as a process initiated by management to ensure reasonable assurance of achieving organizational goals. It encompasses a combination of procedural, structural, and cultural mechanisms aimed at mitigating risks and monitoring financial and operational activities (Bame-Aldred et al., 2013). On the other hand, internal audit focuses on evaluating the effectiveness of the internal control systems, ensuring their alignment with organizational objectives, and providing impartial, evidence-based feedback to senior management. While both concepts are interrelated, they serve distinct yet complementary purposes within an organization (Roussy & Perron, 2018).

In today's interconnected and competitive global economy, the importance of internal audit and

internal control has been amplified. Risk management has become more complex, with organizations facing a multitude of challenges, including technological disruptions, regulatory pressures, and evolving stakeholder expectations. Internal audit functions have transitioned from their traditional roles as compliance and reporting units to more dynamic roles that support strategic decision-making (Kapcı, 2023). Similarly, internal control systems have expanded beyond basic operational checks to integrate broader organizational aspects, such as behavioral factors and cultural alignment. These developments underline the necessity of robust internal audit and internal control frameworks in ensuring organizational resilience and adaptability (Lustrilanang et al., 2023).

The relevance of internal audit and internal control is further highlighted by their role in fostering transparency, accountability, and ethical governance. As organizations navigate challenges such as fraud, financial mismanagement, and reputational risks, these mechanisms provide a structured approach to identifying vulnerabilities and implementing corrective actions (Usul & Alpay, 2024). For instance, internal control systems establish a foundation for maintaining data integrity, safeguarding assets, and ensuring compliance with legal and regulatory standards. Meanwhile, internal audits offer organizations the tools to assess their preparedness in addressing risks and align their operations with strategic objectives. Together, these mechanisms contribute to building trust among stakeholders, including investors, employees, and customers (Spira & Page, 2003).

Despite their critical importance, academic engagement with the topics of internal audit and internal control remains limited, particularly in Türkiye. While international studies have increasingly focused on these areas, examining their impact on organizational performance and governance, there is a noticeable gap in the Turkish context. The lack of comprehensive research that addresses internal audit and internal control jointly points to a missed opportunity to explore their interconnectedness and collective impact on organizational success (Behrend & Eulerich, 2019).

This is especially significant given the growing role of these mechanisms in public and private sector organizations across Türkiye, where economic and regulatory landscapes are undergoing rapid transformation.

Internal audit and internal control are indispensable tools for modern organizations, enabling them to navigate uncertainties, optimize resources, and achieve strategic objectives. Despite their significance, the academic exploration of these topics, particularly in the Turkish context, remains limited. Hence, this study seeks to address this gap by providing a comprehensive bibliometric analysis of graduate theses on internal audit and internal control in Türkiye. By highlighting current trends, identifying gaps, and proposing future directions, this research aims to advance both academic and practical understanding of these critical governance mechanisms.

2. LITERATURE REVIEW

Internal audit and internal control are pivotal concepts in the governance and management of organizations. They serve as mechanisms to ensure the alignment of organizational activities with predefined objectives while mitigating risks and promoting accountability (Kutateladze et al., 2020). The intertwined relationship between these concepts has been the subject of numerous academic inquiries worldwide.

A review of the literature reveals several emerging themes in internal audit and internal control research. First, there is a growing recognition of the importance of integrating these functions with broader organizational processes, such as risk management, fraud prevention, and governance. Second, the evolving role of technology is reshaping traditional audit and control practices, offering both opportunities and challenges. Third, human and behavioral factors are increasingly acknowledged as critical components of effective internal control systems.

This section reviews key studies that have addressed internal audit, internal control, and their interaction, providing insights into their significance, methodologies, and findings, with particular

emphasis on their relevance to accountability, risk management, and organizational performance.

Accountability is a cornerstone of effective governance, and the roles of internal audit and internal control in achieving this have been widely recognized. Sari et al. (2017) investigated the effects of internal audit and internal control on the accountability of public service universities in Indonesia. The study, conducted with 90 participants involved in financial management, found that internal control significantly improved accountability, while internal audit did not exhibit a measurable impact. The findings suggest that internal control provides a structured approach to oversight and risk mitigation, whereas the role of internal audit may depend on the organization's specific operational context and maturity level. The study's methodology, employing regression analysis and the WarpPLS application, highlights the importance of robust analytical frameworks in understanding these relationships. However, it also raises questions about the extent to which internal audits are integrated into broader governance structures. Further research could examine whether factors such as audit quality, auditor competence, or organizational culture influence the effectiveness of internal audits in fostering accountability.

Risk management is an essential aspect of organizational sustainability, and its integration with internal audit and internal control has garnered significant academic interest. Özkardes (2017) explored the relationship between these elements through content analysis of activity reports from companies listed on the BIST KURY Index. The findings indicated a linear correlation between the importance organizations place on risk management and their approaches to internal audit and control. Companies that prioritize risk management were found to allocate more resources to these areas, suggesting a synergistic relationship between risk awareness and governance mechanisms. This study underscores the need for a comprehensive approach to risk management, where internal control systems provide the foundational structure and internal audits ensure the efficacy of those systems. The findings align with global trends emphasizing risk-

based internal auditing (RBIA), which prioritizes audits of high-risk areas. Future research could build on these insights by investigating how technological advancements, such as predictive analytics and artificial intelligence, are transforming the integration of risk management with internal audit and control functions.

The effectiveness of internal control is often linked to the characteristics and competencies of the internal audit function. Oussii and Taktak (2018) examined this relationship using data from 59 chief audit executives in public companies in Tunisia. Their regression analysis revealed that internal control quality was significantly and positively associated with the competence of the internal audit function (IAF), the quality assurance level of internal audits, the follow-up process, and the involvement of audit committees in reviewing internal audit programs and results. This study highlights the importance of human and organizational factors in enhancing the effectiveness of internal control systems. For instance, the competency of internal auditors, their training, and the extent of their independence significantly influence their ability to identify and address weaknesses in internal controls. Moreover, the active involvement of audit committees ensures that findings from internal audits are translated into actionable improvements. These findings could serve as a basis for developing training programs and policy guidelines to strengthen internal audit functions.

The role of information systems in internal audit and control has become increasingly prominent, as evidenced by studies examining their intersection with organizational processes. Yusuf and Kanji (2020) analyzed the impact of internal audit and accounting information systems (AIS) on internal control effectiveness in an automotive trading company in Indonesia. Their findings demonstrated a positive and significant relationship between AIS and internal control, underscoring the importance of integrating technology into governance frameworks.

The study raises intriguing questions about the evolving role of technology in auditing and control. With the advent of big data, cloud computing, and

blockchain, internal audits and controls are no longer confined to traditional manual methods. Instead, they now leverage advanced tools to provide real-time insights, enhance transparency, and improve decision-making processes. Future studies could explore how emerging technologies are reshaping the boundaries of internal audit and control, including their implications for auditor skillsets and organizational structures.

Focusing on Türkiye, Karavardar and Şahintürk (2020) conducted a detailed examination of academic studies on internal audit and internal control between 2009 and 2019. They analyzed 95 articles, 284 theses, and 14 books, identifying 2019 as the year with the highest research output. The study also highlighted that most publications focused on business administration and were associated with specific universities. These findings reveal an emerging interest in internal audit and control within Turkish academia, although the scope remains limited compared to global trends. The dominance of business administration as a research focus suggests that these topics are primarily viewed through the lens of organizational management rather than as interdisciplinary subjects encompassing fields such as psychology, sociology, or technology. Expanding the scope of research to include these perspectives could enrich the understanding of internal audit and control in Türkiye.

Fraud prevention is one of the most critical applications of internal audit and control systems. Handoyo and Bayunitri (2021) investigated this relationship in PT Pos Indonesia (Persero) Bandung, using a verification method with a sample of 91 employees. Their findings confirmed that internal audit and internal control significantly contribute to fraud prevention, emphasizing their role in safeguarding organizational assets and maintaining integrity. The study's emphasis on fraud prevention aligns with global concerns about financial misconduct and the erosion of stakeholder trust. However, the findings also highlight the need for continuous improvement in these areas. For instance, organizations could adopt advanced fraud detection tools, such as machine learning algorithms,

and combine them with traditional audit and control measures to enhance their effectiveness.

The objective of the research conducted by Savlı and Akin (2021) was to ascertain the extent to which businesses operating within the Antalya Organized Industrial Zone effectively implement internal control and internal audit procedures. This was achieved through the utilisation of a survey methodology. The findings of the research indicate that the majority of the 118 businesses that participated in the study are aware of the significance of internal control and internal audit in accounting and auditing practices. The results suggest that businesses should accord greater importance to internal audit and internal control.

In his research, Koç (2022) seeks to elucidate the interrelationship between internal control structures and internal audits, with a particular focus on the evolution of internal audit structures in general. The study provides a comprehensive analysis of internal audit and offers insights into its future direction, which could inform future research in this field.

Internal control and audit are not solely technical functions but also involve significant human and behavioral elements. Abdo et al. (2022) explored the impact of emotional intelligence (EI) on the perceived effectiveness of internal control in Lebanese companies. Their findings demonstrated that the personality traits of audit team members play a crucial role in creating a conducive control climate. This insight shifts the narrative from a purely procedural view of internal control to one that acknowledges the importance of organizational psychology and behavior. This study provides a compelling case for incorporating soft skills into auditor training programs. Emotional intelligence, teamwork, and communication skills are essential for fostering a collaborative and effective control environment. Further research could delve deeper into the interplay between organizational culture and the efficacy of internal control and audit systems.

The dynamic nature of internal audit and control necessitates continuous evolution in research and practice. Hasanah et al. (2024) examined how internal audit, risk assessment, and AIS influence the

effectiveness of receivables collection in an Indonesian company. Their findings suggested that accounting information systems negatively impacted receivables collection, highlighting potential challenges in aligning technological solutions with organizational processes. This study underscores the need for a nuanced approach to integrating technology into internal control and audit functions. While technology offers numerous advantages, its implementation must be tailored to the specific needs and capabilities of the organization. Future research could explore how organizations can balance technological advancements with traditional audit and control practices to achieve optimal outcomes.

Despite these advancements, significant gaps remain. For instance, there is limited research on the interaction between internal audit and control in non-traditional contexts, such as small and medium-sized enterprises (SMEs) or non-profit organizations. Similarly, the impact of cultural and regulatory differences on the implementation of internal audit and control systems remains underexplored. Addressing these gaps could provide a more comprehensive understanding of these functions and their role in organizational success. As briefly discussed, the literature on internal audit and internal control highlights their critical role in promoting accountability, managing risks, and enhancing organizational performance. While significant progress has been made in understanding these concepts, there is a need for more interdisciplinary and context-specific research. This study aims to contribute to this growing body of knowledge by examining the intersection of internal audit and internal control in Türkiye, providing valuable insights for both academia and practice.

3. METHOD OF THE RESEARCH

The primary objective of this study is to perform a comprehensive bibliometric analysis of postgraduate theses in Türkiye that address the topics of internal audit and internal control within the same title. This analysis aims to provide valuable insights into the academic treatment of these critical subjects and to contribute to the broader field of

accounting and governance. By identifying trends and patterns in the academic output, the study seeks to guide future research and inform educational and professional practices.

The research utilized the database of the National Thesis Center of the Council of Higher Education in Türkiye. This database, which serves as a centralized repository of graduate theses, was accessed on October 2, 2024. To identify relevant studies, the keywords “**internal audit**” and “**internal control**” were entered together in the search bar, using the “**thesis title**” field as the search criterion. This approach ensured that the analysis focused exclusively on theses explicitly addressing both concepts in their titles.

The decision to rely on this database was driven by its comprehensiveness and reliability as an authoritative source for academic theses in Türkiye. However, it is acknowledged that this approach may exclude studies where these topics were discussed without being explicitly mentioned in the title or were explored as secondary themes. Future research could expand on this by considering broader keyword searches or incorporating other academic outputs, such as journal articles or conference proceedings.

To conduct a systematic analysis, the following parameters were selected:

1. **Type of Thesis:** The classification of the theses as either master's or doctoral was examined to understand the level of academic engagement with these topics.
2. **Language of Thesis:** The language in which the theses were written (Turkish or English) was recorded to evaluate the accessibility and potential international reach of the research.
3. **Year of Publication:** The temporal distribution of theses was analyzed to identify trends and shifts in research interest over time.
4. **University of Publication:** The institutions where the theses were produced were analyzed to identify academic hubs and contributors to these fields.

5. **Status of Universities:** A distinction was made between public and private universities to assess differences in research output and focus.
6. **Title of Thesis Supervisor:** The academic rank of the thesis supervisors (e.g., Assistant Professor, Associate Professor, Professor) was examined to understand the level of expertise guiding the research.
7. **Subject of Thesis:** The disciplinary focus of the theses, such as business administration or public administration, was analyzed to identify dominant thematic areas.
8. **Research Methods:** The methodologies employed in the theses (e.g., qualitative, quantitative, compilation, or model building) were categorized to provide insights into the prevailing research approaches.

Two primary analytical methods were employed in this study:

1. **Descriptive Analysis:** Percentage and frequency analyses were used to quantify the distribution of theses across the selected parameters. This method allowed for a straightforward representation of the data, highlighting key trends and patterns.
2. **Content Analysis:** To complement the descriptive analysis, a content analysis method was applied. This approach enabled the interpretation of the underlying themes and contexts of the theses, providing a richer understanding of the research landscape. Content analysis involved categorizing and interpreting the data to draw inferences about the focus areas and contributions of the theses.

The chosen bibliometric approach offers a robust framework for analyzing academic trends in internal audit and internal control research. By focusing on specific parameters, the study provides a multidimensional view of the research landscape, encompassing institutional, methodological, and thematic aspects. The combination of descriptive and content analysis ensures both quantitative and

qualitative insights, making the findings relevant for academia, policymakers, and practitioners.

However, it is important to note certain limitations inherent in this methodology. The reliance on a single database means that the findings are specific to the theses indexed by the National Thesis Center and may not fully capture the diversity of research on internal audit and internal control in Türkiye. Moreover, the focus on titles as the primary search criterion may exclude studies where these topics are discussed implicitly.

This methodological approach is expected to yield valuable insights into the state of academic research on internal audit and internal control in Türkiye. By identifying trends, gaps, and opportunities, the study provides a foundation for future research and encourages greater academic engagement with these topics. Additionally, the findings can inform educational policies and curricula, ensuring that emerging professionals in accounting and governance are equipped with the knowledge and skills necessary to address these critical areas.

4. ANALYSIS AND DISCUSSION OF RESULTS

This section presents and discusses the findings from the bibliometric analysis of postgraduate theses in Türkiye that address the topics of internal audit and internal control. By examining the data through various parameters, the study sheds light on trends, gaps, and opportunities in academic research. Each table is analyzed in detail, with significant findings highlighted and their implications discussed comprehensively.

As seen in Table 1, the majority of theses addressing internal audit and internal control are master's level (10 out of 12), with doctoral-level research comprising a much smaller share (2 out of 12). This distribution suggests that while internal audit and internal control are recognized as important topics in postgraduate education, they may not yet be a focal point for advanced academic research at the doctoral level in Türkiye. This imbalance could be due to the nascent stage of these topics in Turkish academia or a lack of specialization opportunities at the doctoral level.

Table 1. Distribution of Thesis Types

Thesis Type	Frequency	Percentage
Master's Thesis	10	83.3%
Doctoral Thesis	2	16.7%
Total	12	100.0%

This finding underscores the need to encourage doctoral-level research to explore these topics in greater depth, contributing to theory development and advanced practical applications. Universities and funding agencies could incentivize research in these areas through scholarships, grants, and dedicated doctoral programs.

Table 2. Distribution of Theses by Language

Thesis Type	Turkish	English	Total
Master's Thesis	10	0	10
Doctoral Thesis	1	1	2
Total	11	1	12

Table 2 shows that the overwhelming majority of theses were written in Turkish (11 out of 12), with only one thesis authored in English. This language preference reflects the national orientation of the research and may limit the international visibility and impact of these studies. Writing in Turkish ensures accessibility for local audiences, including practitioners and policymakers in Türkiye, but it also creates barriers to participation in the global academic discourse.

Promoting bilingual research outputs, particularly at the doctoral level, could enhance the global relevance and recognition of Turkish contributions to internal audit and internal control. This can be achieved by integrating English-language publication requirements into postgraduate programs and offering resources for academic writing in English.

Table 3. Chronological Distribution of Theses

Year Published	Master's Thesis	Doctoral Thesis	Total
2010	1	0	1
2011	1	0	1
2016	1	0	1
2018	3	0	3
2019	1	0	1

Year Published	Master's Thesis	Doctoral Thesis	Total
2021	2	0	2
2022	0	1	1
2023	1	1	2
Total	10	2	12

The chronological data, shown in Table 3 reveals a sporadic pattern of thesis publication, with peaks observed in 2018 and 2021. Notably, doctoral-level research only emerged in recent years, with theses published in 2022 and 2023. The recent appearance of doctoral theses may reflect growing academic interest in internal audit and internal control as research areas.

The peak in 2018 could be attributed to increased academic or regulatory attention to internal audit and control during this period. Further analysis of external factors, such as policy changes or economic developments, may help contextualize these trends. Encouraging consistent research output through academic incentives and targeted funding can help sustain interest and production in this field.

Table 4. Distribution of Theses by Universities

Universities	Master's Thesis	Doctoral Thesis	Total
Muğla Sıtkı Koçman University	1	0	1
Marmara University	1	0	1
Okan University	2	0	2
Süleyman Demirel University	2	1	3
İstanbul Ticaret Üniversitesi	1	1	2
Ufuk University	1	0	1
İstanbul Bilgi University	1	0	1
Giresun University	1	0	1
Total	10	2	12

Table 4 reveals significant variability in the distribution of theses among universities, with only a few institutions emerging as prominent contributors to research on internal audit and internal control. **Süleyman Demirel University** stands out with three theses, including one doctoral thesis, making it the most active institution in this domain. Other notable contributors include **İstanbul Ticaret Üniversitesi**, which produced both master's and

doctoral theses, and **Okan University**, with two master's theses.

This uneven distribution highlights a concentration of expertise and interest in specific universities, which may reflect the presence of specialized academic programs or faculty expertise in internal audit and internal control. However, the low output from other institutions, including many prominent Turkish universities, suggests that these topics are not yet widely integrated into postgraduate research curricula across the country.

The dominance of a few universities could also be indicative of the localized nature of academic interest and funding opportunities in Türkiye. Expanding research capacity to other institutions through inter-university collaborations, joint research programs, and the establishment of specialized centers could help broaden the scope and impact of research in this field. Furthermore, incentivizing research through grants and partnerships with professional organizations such as the Institute of Internal Auditors (IIA) Türkiye could encourage more universities to engage with these critical topics.

It is also notable that private universities such as **Okan University** and **İstanbul Bilgi University** have contributed to this field, reflecting a growing interest in research beyond the traditionally dominant public institutions. This trend suggests that private universities are beginning to recognize the academic and practical importance of internal audit and control, which could lead to more diversified contributions in the future.

Table 5. Distribution of Theses by Ownership of Universities

Status	Master's Thesis	Doctoral Thesis	Total
Public University	6	2	8
Private University	4	0	4
Total	10	2	12

As seen in Table 5, public universities dominate thesis production, with eight theses originating from these institutions, compared to four from private universities. This finding is consistent with the broader trend of public universities being primary contributors to academic research in Türkiye.

The predominance of public universities may reflect their stronger emphasis on research as part of their academic mission. However, the growing presence of private universities in this field highlights an opportunity for collaboration and knowledge sharing between public and private institutions to enrich the research ecosystem.

Table 6. Distribution of Theses by Academic Titles of Supervisors

Academic Title	Master's	Doctoral	Total
Assistant Professor	1	1	2
Associate Professor	5	0	5
Full Professor	4	1	5
Total	10	2	12

Table 6 indicates that most master's theses were supervised by associate professors and full professors, while doctoral theses had advisors at all academic ranks. This distribution suggests that experienced faculty members are more likely to guide research in internal audit and control, potentially due to the specialized knowledge required.

The involvement of senior academics is promising as it enhances the credibility and quality of the research. However, increasing opportunities for junior academics (e.g., assistant professors) to participate in this field could diversify perspectives and expand research capacity.

Table 7. Distribution of Theses by Subject

Subject	Master's Thesis	Doctoral Thesis	Total
Business	8	1	9
Public Administration	1	1	2
Banking	1	0	1
Total	10	2	12

Most theses focus on business administration, with limited attention to public administration and banking (Table 7). This emphasis reflects the central role of internal audit and control in corporate governance and risk management, but it also highlights a need for broader exploration across sectors.

Expanding research into public administration, healthcare, and non-profit organizations could enhance understanding of how internal audit and control operate in diverse contexts, offering valuable insights for theory and practice.

Table 8. Distribution of Theses by Research Methods

Method	Master's Thesis	Doctoral Thesis	Total
Qualitative	1	1	2
Quantitative	6	1	7
Compilation	1	0	1
Model Building	2	0	2
Total	10	2	12

Finally, Table 8 depicts that quantitative methods dominate the research landscape, accounting for seven theses, while qualitative and mixed-method approaches are less common. This reliance on quantitative methods may reflect the suitability of numerical and statistical approaches for analyzing internal audit and control phenomena.

The limited use of qualitative and mixed methods suggests a potential area for methodological diversification. Exploring case studies, interviews, and ethnographic approaches could provide richer insights into the human and organizational dimensions of internal audit and internal control.

5. DISCUSSION

The bibliometric analysis reveals that internal audit and internal control research in Türkiye is an emerging field, primarily concentrated at the master's level and in Turkish. The dominance of public universities and quantitative methods highlights strengths but also points to opportunities for diversification in institutional participation, research methods, and thematic focus.

The distribution of theses across universities underscores a concentration of research activity within a few institutions, particularly Süleyman Demirel University and İstanbul Ticaret Üniversitesi. These institutions have emerged as leaders in producing academic work in this field, potentially reflecting their specialized programs or faculty expertise. However, the limited contribution from many other universities, including some of Türkiye's

prominent institutions, suggests an uneven engagement with these topics across the higher education landscape. Expanding research capacity to a broader range of universities is essential to ensure more equitable academic contributions and to build a robust national research framework.

To address this, stakeholders should encourage broader institutional engagement by incentivizing research on internal audit and internal control in underrepresented universities. Resource allocation, such as targeted funding and grants, can play a critical role in enabling these institutions to build capacity in this area. Additionally, fostering inter-university collaborations, particularly between active research institutions and less-engaged universities, could help share expertise, methodologies, and resources. Establishing regional research hubs, with leading institutions like Süleyman Demirel University at the core, could further enhance research networks and create a more cohesive academic ecosystem.

In advancing the field, stakeholders should also promote interdisciplinary research that incorporates perspectives from fields such as psychology, technology, and public administration. International collaboration can provide valuable comparative insights, particularly by engaging with regions where internal audit and internal control are more mature fields of study. Methodological innovation, such as the integration of qualitative and mixed methods alongside traditional quantitative approaches, can provide deeper insights into the complexities of internal audit and control.

By addressing these gaps, researchers can diversify its research contributions and elevate its role in global discussions on internal audit and internal control. This would not only enhance the relevance of Turkish research in governance and organizational sustainability but also position Türkiye as a key contributor to addressing the challenges and opportunities of internal audit and internal control in a globalized economy.

6. CONCLUSION

Internal audit and internal control are pivotal elements of organizational governance and sustainability. Their roles in risk management,

accountability, and operational efficiency are critical in a dynamic global business environment. These mechanisms enable organizations to navigate complexities, ensure compliance, safeguard assets, and align operations with strategic objectives. Despite their importance, academic research integrating these topics remains underexplored in Türkiye, leaving significant gaps in understanding their application and interrelation. This study provides a bibliometric analysis of graduate theses in Türkiye that address internal audit and internal control within the same title, offering valuable insights into the academic landscape and laying the groundwork for future research.

Internal audit and internal control are no longer peripheral functions but central to modern organizational success. Internal control serves as a system designed by management to monitor, mitigate, and respond to risks, ensuring that organizational goals are met efficiently and effectively. Internal audit, in turn, evaluates the robustness and implementation of internal control systems, providing independent and objective assurance to senior management. The integration of these functions has gained prominence due to their collective impact on fraud prevention, risk management, compliance, and strategic decision-making. Moreover, the advent of technological advancements, globalization, and heightened regulatory scrutiny has amplified their relevance. Organizations that prioritize robust internal audit and control frameworks are better equipped to foster transparency, maintain stakeholder trust, and achieve sustainable growth. Given these stakes, the academic exploration of these topics is essential for developing best practices and informing organizational policies.

Academic research is crucial for advancing the understanding and application of internal audit and internal control in organizational contexts. Graduate theses, in particular, represent an essential component of this academic engagement, offering in-depth analyses and novel perspectives on these topics. However, a bibliometric examination of graduate theses in Türkiye reveals that studies addressing both internal audit and internal control

are sparse. Most of the existing research focuses on one of the two topics, often treating them as isolated domains rather than interconnected components of a unified governance framework. This fragmented approach limits the ability to derive holistic insights and apply them effectively in practice.

Recognizing this gap, the present study aims to conduct a bibliometric analysis of graduate theses in Türkiye that address internal audit and internal control together. This study's bibliometric analysis of postgraduate theses reveals significant trends and gaps in Turkish academic research on internal audit and internal control. By examining theses available through the National Thesis Center of the Council of Higher Education, this study seeks to provide a comprehensive overview of the academic landscape in this field. Specifically, it evaluates key parameters such as thesis type, language, year of publication, university affiliation, research methodologies, and thematic focus. Through this analysis, the study sheds light on prevailing trends and identifies potential areas for future research.

One of the significant contributions of this research is its potential to inform both academic and professional practices. By mapping the existing body of knowledge, this study highlights gaps that need to be addressed to enhance the understanding and application of internal audit and internal control. Furthermore, the insights generated from this analysis can serve as a foundation for developing targeted educational programs and professional training initiatives. For instance, identifying universities and academic departments that are actively engaged in these topics can help foster collaborations and create opportunities for interdisciplinary research.

Additionally, this study emphasizes the need for a more integrated approach to studying internal audit and internal control. While both concepts are often discussed separately in the literature, their interconnectedness is crucial for addressing complex organizational challenges. For example, the effectiveness of internal control systems is often contingent on the quality of internal audits, which provide the oversight and feedback necessary for

continuous improvement. Similarly, the strategic insights generated by internal audits can only be realized if they are supported by robust internal control mechanisms. By analyzing these interdependencies, this research contributes to a more comprehensive understanding of how internal audit and internal control can collectively enhance organizational performance.

The findings of the study highlight that most theses in the field are master's level, with doctoral research making up a smaller proportion. This indicates that while there is interest at the introductory postgraduate level, deeper theoretical and empirical exploration at the doctoral level remains limited. Encouraging doctoral research could bridge this gap and provide more advanced insights. The overwhelming majority of theses are written in Turkish, with only one authored in English. This finding reflects a localized academic focus, limiting international accessibility and participation in global discussions. Promoting bilingual research outputs, especially for doctoral theses, could enhance the global impact of Turkish research.

A few universities, notably Süleyman Demirel University and İstanbul Ticaret Üniversitesi, dominate the research output. This uneven distribution highlights the need for broader institutional engagement, inter-university collaborations, and resource allocation to underrepresented universities. Quantitative methods dominate the field, while qualitative and mixed-method approaches are underutilized. Incorporating diverse methodologies, such as case studies, interviews, and ethnographic research, could provide richer insights into the human and organizational dimensions of internal audit and control. Most theses focus on business administration, with limited attention to public administration or banking. This narrow thematic scope indicates an opportunity to explore the applicability of internal audit and control across various sectors, such as healthcare, non-profit organizations, and public governance. The publication of theses has been sporadic, with peaks in certain years. The emergence of doctoral theses in recent years suggests growing academic interest, but

consistent research output is necessary to sustain momentum.

This study contributes to the literature by mapping the academic landscape of internal audit and internal control research in Türkiye. The findings provide a comprehensive overview of existing research trends, institutional contributions, and methodological approaches. By identifying key gaps, the study lays a foundation for targeted academic and professional initiatives. Specifically, it highlights the importance of developing theoretical frameworks. Most research focuses on practical applications, with limited theoretical exploration. Encouraging studies that develop and test theoretical models could enrich the academic discourse and inform global best practices. The dominance of quantitative methods suggests a preference for numerical analysis. However, the integration of qualitative and mixed methods could provide deeper contextual insights and address complex organizational dynamics. Internal audit and internal control intersect with fields such as psychology, sociology, technology, and public administration. Interdisciplinary studies could enhance understanding and applicability across diverse organizational contexts. The focus on Turkish-language research limits international visibility. Publishing in English and engaging in cross-cultural studies could position Turkish academia as a significant contributor to global discussions on internal audit and control.

The findings also have practical implications for organizations, policymakers, and educational institutions. Organizations should emphasize the integration of internal audit and control as complementary functions that enhance governance and strategic decision-making. Investment in training programs to equip internal auditors and control professionals with interdisciplinary skills, including technological literacy and behavioral insights, would be valuable. Policymakers should develop regulatory frameworks that mandate robust internal audit and control practices across sectors and provide funding and incentives for academic research that addresses gaps in understanding and application. Educational institutions should integrate internal audit and control into postgraduate

curricula, emphasizing their practical and theoretical importance. Establishing research centers and networks to foster collaboration among universities, practitioners, and policymakers would further advance the field.

This study identifies several avenues for future research. While business administration dominates current research, future studies could explore internal audit and control in public administration, healthcare, non-profits, and SMEs. Research could investigate how emerging technologies, such as artificial intelligence, blockchain, and data analytics, are transforming internal audit and control practices. Examining how organizational culture, leadership styles, and national culture influence the effectiveness of internal audit and control could provide valuable insights. Future research could integrate perspectives from psychology, sociology, and behavioral sciences to explore the human dimensions of internal audit and control. Cross-country studies could provide comparative insights into the adoption and impact of internal audit and control practices, highlighting best practices and contextual differences. Tracking the evolution of internal audit and control practices over time could offer insights into their adaptation to changing organizational and environmental conditions.

This study underscores the importance of these functions by analyzing academic research trends in Türkiye, identifying key findings, and highlighting opportunities for growth. While the study reveals strengths, such as the emerging interest in these topics and the contributions of leading universities, it also exposes significant gaps in language, methodology, and thematic focus. Addressing these gaps requires a concerted effort from academia, industry, and policymakers to advance the field and ensure its relevance in addressing contemporary organizational challenges. By promoting interdisciplinary research, encouraging global engagement, and expanding thematic and methodological diversity, Turkish academia can play a pivotal role in shaping the future of internal audit and control. These efforts will not only enhance the academic and practical understanding of these functions but also contribute to their adoption as

integral components of governance and sustainability worldwide.

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MAPPING BLOCKCHAIN'S IMPACT ON COLD CHAIN LOGISTICS: INSIGHTS FROM BIBLIOMETRIC AND CO-CITATION ANALYSIS

Nesrin ÖZCAN AKDAĞ*

* Ph.D. Candidate, Süleyman Demirel University Institute of Social Sciences, Department of Business Administration, YOK 100/2000 Logistic Doctoral Scholarship Program, nsrnozcan@gmail.com, <https://orcid.org/0000-0001-8980-4459>.

ABSTRACT

Blockchain technology has emerged as a transformative solution for enhancing transparency, traceability, and operational efficiency in cold chain logistics, particularly for temperature-sensitive goods. However, despite its growing importance, a comprehensive understanding of its application in this domain remains limited. This study aims to map the academic literature on blockchain in cold chain logistics by conducting bibliometric and co-citation analyses of 112 papers retrieved from Scopus and Web of Science databases. For these analyses, the Biblioshiny and Bibliometrix libraries, tools for comprehensive science mapping analysis, were utilized within R Studio. The analysis explores publication trends, thematic evolution, and collaboration networks, offering a structured overview of the current research landscape. Key findings reveal a surge in publications during the COVID-19 pandemic, driven by the need for reliable vaccine distribution systems. Dominant themes include the integration of blockchain with Internet of Things (IoT), machine learning, and traceability systems, reflecting technological advancements in real-time monitoring and predictive analytics. Collaboration analysis identifies China and Canada as leading contributors, though regional disparities in research activity persist. This study contributes to the literature by identifying research gaps, such as the scalability and cost-effectiveness of blockchain in cold chain logistics, and by proposing actionable insights for future studies. It highlights opportunities for cross-disciplinary research and emphasizes the importance of standardizing blockchain frameworks for global adoption. For practitioners, the findings underscore the potential of blockchain to optimize supply chains and reduce losses in critical sectors like healthcare and food logistics. This paper serves as a reference for academics and industry stakeholders, providing a foundation for advancing research and practical applications in this evolving field.

Keywords: Cold Chain Logistics, Blockchain, Bibliometric Analysis, Co-citation Analysis.

1. INTRODUCTION

The rapid globalization and growing interconnectivity of supply chains have significantly enhanced the efficiency and reach of modern logistics systems. However, these advancements have also introduced greater complexity and susceptibility to disruptions, particularly in cold chain logistics, which are essential for transporting temperature-sensitive goods such as vaccines, pharmaceuticals, and perishable foods. Inadequate management of temperature-controlled logistics systems can result in severe economic losses, public health crises, and sustainability challenges. For instance, disruptions in cold chain systems during the COVID-19 pandemic underscored the need for enhanced transparency, accountability, and traceability in global supply chains. The pandemic

revealed weaknesses in existing cold chain logistics infrastructure, highlighting an urgent need for technologies that can provide real-time monitoring, improved data integrity, and operational efficiency (Halim et al., 2021; Jiang et al., 2024).

In response to these challenges, blockchain technology has emerged as a revolutionary solution to address critical issues in cold chain logistics. Introduced in the 2008 white paper *Bitcoin: A Peer-to-Peer Electronic Cash System* by Satoshi Nakamoto, blockchain has revolutionized industries by offering decentralized, immutable, and secure data-sharing capabilities (Hofmann et al., 2017; Lal, 2020). Unlike traditional systems that rely on centralized intermediaries prone to inefficiencies and inaccuracies, blockchain enables transparent and tamper-proof data sharing across stakeholders. This

is particularly important for cold chains, where deviations from required temperature ranges can compromise product quality and safety. Blockchain, when combined with complementary technologies like the Internet of Things (IoT), machine learning, and artificial intelligence, offers immense potential to enhance the traceability, reliability, and sustainability of cold chain systems (Cil et al., 2022; Rejeb et al., 2022).

The significance of blockchain in cold chain logistics is underscored by its ability to address challenges related to transparency, traceability, and operational inefficiency. For instance, IoT-enabled blockchain systems allow stakeholders to monitor real-time temperature, location, and handling conditions, preventing spoilage and enhancing supply chain resilience (Shashi et al., 2018; Hu, 2022). By securely recording every transaction and process step, blockchain provides an immutable record of goods' journeys, improving accountability. This is especially crucial in critical sectors like healthcare and food logistics, where product integrity is paramount (Nofer et al., 2017; Bamakan et al., 2021).

Despite the promising potential of blockchain technology, its adoption in cold chain logistics remains in its early stages. The academic literature on this topic is fragmented, with limited interdisciplinary studies exploring its full applications. Research on blockchain in broader supply chain management is extensive, but specific studies on cold chains are relatively few (Rejeb et al., 2022). This gap highlights the need for a comprehensive synthesis of existing knowledge to inform both researchers and practitioners. Such an effort would identify current trends, dominant themes, and gaps while pointing to future opportunities for blockchain implementation (Masudin et al., 2021; Zhang et al., 2022).

The COVID-19 pandemic further amplified the need for robust cold chain systems and accelerated the adoption of blockchain in logistics. From 2020 to 2022, there was a marked increase in academic research exploring blockchain's applications in cold chains, particularly for vaccine distribution (Mustafa et al., 2024). This period saw the emergence of new

research themes, such as the integration of blockchain with IoT, machine learning, and cryptographic systems, which collectively improve real-time monitoring and efficiency (Sunny et al., 2020). However, challenges remain, including scalability issues, high implementation costs, and regulatory barriers that limit blockchain's widespread adoption, particularly among small and medium-sized enterprises (Mustafa et al., 2024; Ramírez et al., 2022).

Bibliometric analysis offers a powerful method to synthesize the growing body of literature on blockchain in cold chain logistics. It allows for the identification of key trends, influential studies, and collaborative networks within a research domain (Aria & Cuccurullo, 2017; Rejeb, 2022). Co-citation analysis further enables the mapping of intellectual foundations and emerging themes by examining relationships between cited works. These tools are particularly valuable for evaluating blockchain research, which spans diverse disciplines such as computer science, logistics, and sustainability (Cil et al., 2022; Shen et al., 2022).

To address the fragmented state of the literature, this study employs bibliometric and co-citation analyses to map the intellectual landscape of blockchain research in cold chain logistics. A total of 112 peer-reviewed papers were retrieved from Scopus and Web of Science, two leading academic databases known for their comprehensive coverage and reliability. These analyses were conducted using the *Biblioshiny* and *Bibliometrix* libraries within R Studio, tools widely recognized for their robustness in science mapping (Aria & Cuccurullo, 2017). The research focuses on identifying publication trends, thematic areas, and collaboration networks to provide a structured overview of this evolving field.

The objectives of this study are threefold. First, it aims to provide a comprehensive overview of the research landscape by analyzing publication trends, authorship patterns, and institutional collaborations. Second, it seeks to identify thematic areas and emerging trends in blockchain applications for cold chain logistics. Third, it highlights research gaps and proposes future research directions to advance the

field. By addressing these objectives, this study contributes to both theory and practice. It offers valuable insights for academics seeking to build upon existing knowledge and actionable guidance for industry stakeholders exploring blockchain adoption in cold chain systems.

The findings of this study are expected to contribute significantly to both academia and industry. For researchers, the results provide a comprehensive synthesis of the current state of knowledge, highlighting areas for future inquiry and interdisciplinary collaboration. For practitioners, the insights offer actionable guidance on leveraging blockchain to enhance cold chain operations, improve traceability, and ensure product quality. Policymakers will also benefit from these findings, which emphasize the need for standardized protocols and incentives to promote blockchain adoption in critical sectors (Halim et al., 2021; Shen et al., 2022).

This paper is structured as follows: After the introduction, the methodology section describes the bibliometric and co-citation analysis methods used in this study, along with the data collection process. The results section presents key findings, including publication trends, collaboration networks, and thematic areas. The discussion section critically interprets these findings, highlighting their implications for theory and practice. Finally, the conclusion summarizes the study's contributions, discusses its limitations, and offers recommendations for future research.

By synthesizing the current knowledge base and offering actionable recommendations, this study aims to bridge the gap between theory and practice, fostering innovation and sustainability in cold chain logistics. Blockchain technology's transformative potential positions it as a cornerstone of resilient and transparent supply chains, capable of meeting the demands of an increasingly interconnected and sustainability-focused world.

2. BACKGROUND

The rapid expansion of global supply chains has brought with it new challenges, particularly in industries reliant on the integrity of temperature-

sensitive goods, such as pharmaceuticals, food products, and medical supplies. Cold chain logistics has become critical for these sectors, ensuring that products are transported, stored, and delivered under specific temperature conditions to maintain their quality and safety. However, traditional cold chain systems are often inefficient, prone to disruptions, and vulnerable to fraud. The increasing demand for transparency, traceability, and sustainability within these systems has driven the exploration of new technologies, with blockchain emerging as one of the most promising solutions.

In a recent study, Mustafa et al. (2024) conducted a bibliometric analysis of 114 academic publications in the field of Food Cold Chain Logistics and Management (FCCLM). Their research highlights the growing importance of sustainability and technological advancements such as radio frequency identification (RFID) and the Internet of Things (IoT) in optimizing cold chain systems. The study identifies six principal research clusters, revealing the diverse ways in which emerging technologies are transforming the sector. However, Mustafa et al. (2024) also point out several key gaps in the existing literature, including the lack of research on human factors in food cold chain logistics and the impact of climate change. These gaps represent areas of significant concern and opportunities for further research.

Blockchain technology, a decentralized, immutable, and secure digital ledger, has gained considerable attention for its potential to address these shortcomings in cold chain logistics. Blockchain provides a transparent, real-time, and verifiable way of tracking and managing transactions throughout the supply chain. Haoran (2024) explores the application of blockchain technology in cold chain finance to resolve information asymmetry and trust issues, which are inherent in traditional cold chain logistics finance models. By implementing blockchain, cold chain logistics can benefit from enhanced trust and real-time data validation, ensuring that transactions are not tampered with or delayed. Haoran (2024) uses empirical case studies to substantiate the potential of blockchain to streamline

operations, improve data integrity, and reduce the risk of fraud.

In addition to addressing financial and trust-related challenges, blockchain technology also has significant potential to resolve structural issues in cold chain logistics systems. Zhang et al. (2023) propose a blockchain-based model designed to mitigate the centralization issues that are commonly found in traditional cold chain logistics systems (CCLS). These centralized systems often suffer from inefficiencies in data access, validation, and pricing. Blockchain offers a decentralized solution that ensures data immutability and traceability, providing greater security, efficiency, and cost-effectiveness. Zhang et al. (2023) optimize this model through the application of Stackelberg game theory, which improves the allocation of data resources in the system. This integration of blockchain with game theory aims to create a more secure, efficient, and economical logistics system, with better resource distribution and minimized operational risks.

In agricultural cold chain logistics, Si (2022) presents a private blockchain system that addresses challenges related to the storage and authorization of transactions within the blockchain framework. This system enables controllable sharing and transactions of data while ensuring secure access and management. Si (2022) highlights the efficiency of blockchain in agricultural cold chain logistics, where the analysis of data between 2017 and 2021 reveals high efficiency (above 0.9). However, Si (2022) suggests that improvements can be made both at the technical and management levels of agricultural cold chain logistics. The need for better integration, more robust systems, and standardized protocols is evident as the agricultural sector seeks to reduce waste and improve the efficiency of cold chain operations.

Pharmaceutical cold chains also stand to benefit significantly from blockchain technology. Bamakan et al. (2021) take a comprehensive approach to exploring how blockchain can address the specific challenges of the pharmaceutical cold chain, which often deals with highly regulated, temperature-sensitive products. The authors analyze five case studies to demonstrate how blockchain can meet

critical requirements, such as digital identification of medicines, serialization, traceability, data integrity, transparency, and waste management. Despite these advantages, Bamakan et al. (2021) acknowledge several limitations of blockchain in pharmaceutical chains, including issues related to regulatory compliance, high implementation costs, and scalability concerns. These limitations suggest that while blockchain has great potential, further research and development are necessary to optimize its application in pharmaceutical logistics.

The broader implications of blockchain for supply chain management are examined in a bibliometric review by Rejeb et al. (2021). Their analysis of 628 papers published between 2016 and 2020 reveals a significant increase in blockchain-related research, particularly since 2017. The review identifies key areas of focus, such as blockchain's role in sustainability, the barriers to its adoption, and the security challenges in supply chains. Rejeb et al. (2021) also highlight the leading countries in blockchain research—namely the United States, China, and India—which are at the forefront of both technological innovation and academic research in the field. Despite the growing body of literature, Rejeb et al. (2021) point out the gaps in understanding the full potential of blockchain, particularly regarding the integration of blockchain into complex, global supply chains and the legal, economic, and technological challenges that come with such integration. These findings underscore the need for more comprehensive studies that explore blockchain's application across various sectors and its long-term impact on supply chain management.

Blockchain's application is also evident in healthcare logistics, where it has the potential to optimize blood supply chains. Kim & Kim (2018) propose a novel blockchain-based system designed to address the limitations of existing centralized blood management systems. The authors point out that traditional systems are often slow to provide real-time data, particularly in emergency situations, where the need for immediate access to information is critical. The proposed blockchain system offers a more efficient and transparent approach to blood logistics, improving the speed of response during

emergencies and ensuring that blood supplies are maintained at the correct temperature. This example demonstrates blockchain's potential not only in traditional cold chain logistics but also in critical healthcare supply chains, where data integrity and timely access are essential for saving lives.

Together, these studies highlight the significant potential of blockchain technology in transforming cold chain logistics across various sectors. The ability to provide transparency, traceability, and real-time data validation offers immense benefits, particularly in sectors where the integrity of goods is paramount, such as pharmaceuticals, food safety, and healthcare. However, as highlighted by multiple studies, the integration of blockchain into existing cold chain systems is not without its challenges. Issues such as scalability, high implementation costs, and regulatory compliance need to be addressed before blockchain can be adopted on a large scale.

The research also reveals that the current body of literature is fragmented, with a lack of comprehensive studies that examine the broader implications of blockchain adoption across various cold chain sectors. While the technology has demonstrated success in specific case studies, further research is needed to explore how blockchain can be effectively integrated into complex, global supply chains, particularly in resource-constrained environments. Furthermore, the human factors involved in blockchain adoption, such as workforce

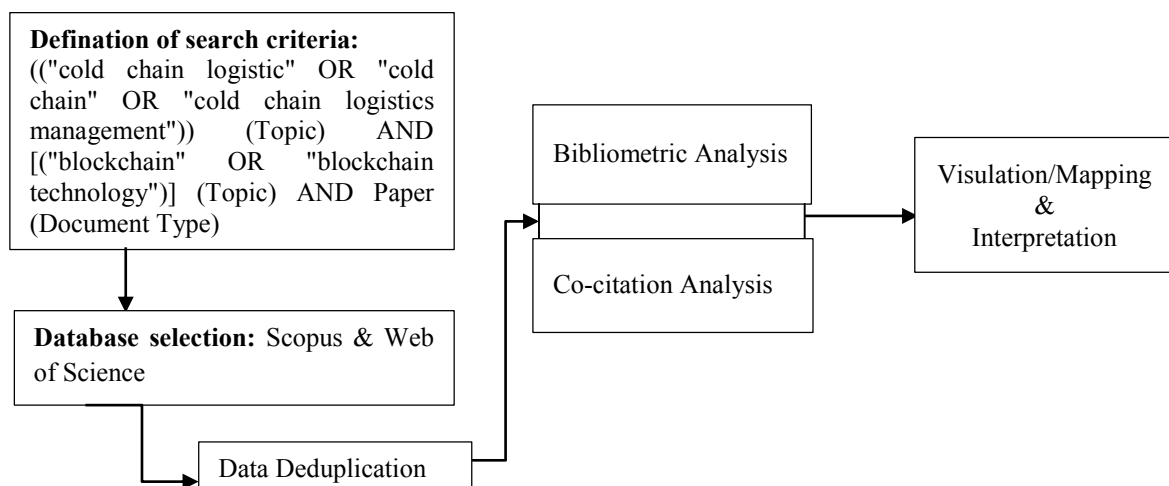
training and user acceptance, have received limited attention in the literature (Mustafa et al., 2024). These gaps represent significant opportunities for future research, particularly in understanding the challenges and opportunities of blockchain technology from both a technological and human-centric perspective.

Overall, while blockchain holds significant promise for revolutionizing cold chain logistics, there is still much work to be done to fully realize its potential. The integration of blockchain with other emerging technologies such as IoT, machine learning, and artificial intelligence could further enhance its capabilities, creating smart cold chains that proactively manage risks and optimize operations. As the field continues to evolve, it will be essential for researchers, practitioners, and policymakers to collaborate to address the barriers to blockchain adoption and to ensure that the technology can deliver its full benefits in the complex and ever-evolving world of cold chain logistics.

3. DATA AND METHODOLOGY

This study aims to identify trends, thematic areas, and future directions in research on blockchain applications in cold chain logistics, as reflected in papers published in the Scopus and Web of Science (WOS) databases. The analysis process is depicted in Figure 1.

Figure 1. Research Analysis Process (Source: Authors' Drawing)



The initial step involved defining the search criteria to ensure a comprehensive collection of relevant data. The search terms were structured as follows: ("cold chain logistic" OR "cold chain" OR "cold chain logistics management") (Topic) AND [("blockchain" OR "blockchain technology")] (Topic) AND Paper (Document Type). These terms encompassed key topics related to both cold chain logistics and blockchain technology. The search was restricted to papers and carried out using subject headings in both databases.

Two prominent academic databases, Scopus and WOS, were selected to ensure robust and reliable data retrieval. The search yielded 105 papers from Scopus and an additional 41 papers from WOS. After combining the datasets, duplicate entries were identified and removed, resulting in a final dataset of 112 unique papers.

Following data consolidation, two analytical methods were applied to the cleaned dataset: bibliometric analysis and co-citation analysis. The use of bibliometric analysis as a research method has increased significantly in the social sciences in recent years (Başdeğirmen, 2023). The bibliometric analysis method enables researchers to make comparisons between countries, institutions or years on a range of subjects. The underlying assumption of co-citation analysis is that two documents are more likely to be related when they refer to the same author, publication or journal together (Rejeb, 2022).

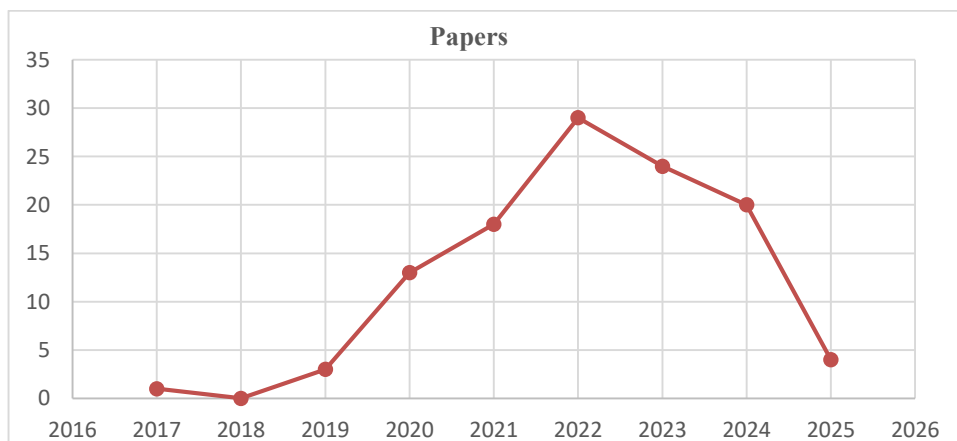
4. DATA ANALYSIS AND VISULATION

This section presents the findings of the bibliometric and co-citation analyses conducted on the paper. The findings from these analyses were visually represented and interpreted. The visualization and mapping phase aimed to clearly illustrate the structure and focal points of blockchain-related academic literature in cold chain logistics, providing insights into key trends and research themes.

Publication Trends

The annual publication trends, illustrated in Figure 2, show a significant growth in academic interest in blockchain applications for cold chain logistics. From a single publication in 2017, the field saw a steady rise, culminating in 29 papers published in 2022. This upward trajectory highlights the increasing recognition of blockchain's potential in addressing logistical challenges, particularly in response to the COVID-19 pandemic. Notably, the pandemic spurred research due to the critical need for reliable vaccine distribution systems. However, a slight decline in publications occurred in 2023 and 2024, with 24 and 20 papers respectively. Despite this dip, the consistent output indicates sustained interest, and projections suggest a potential resurgence in 2025 as global recovery processes progress.

Figure 2. Annual Scientific Production

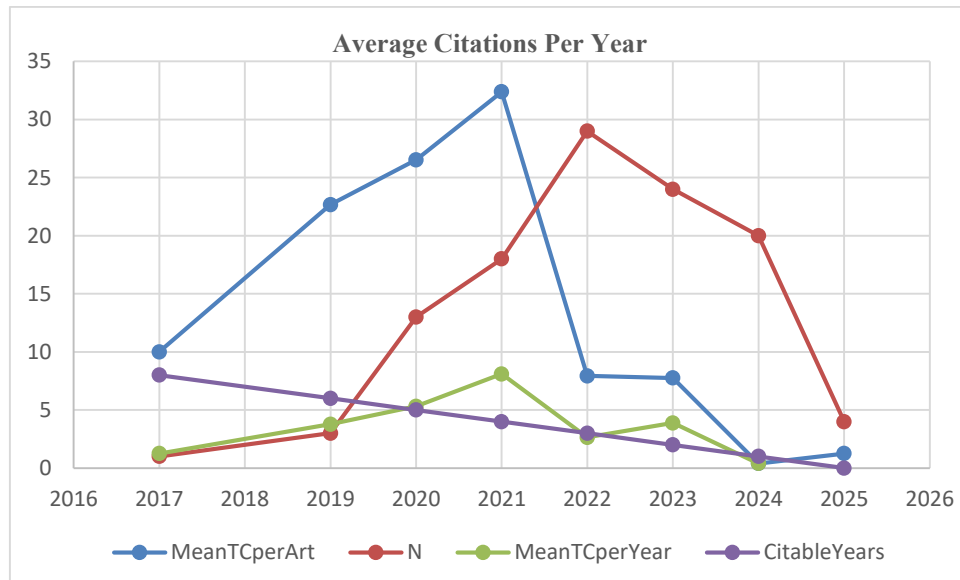


Citation Analysis

Figure 3 provides insights into the citation patterns of the analyzed papers. The highest average citation per paper was observed in 2021, with a mean of 32.39 citations, underscoring the impact of research published during this period. This peak reflects the growing relevance of blockchain technologies in

critical logistics operations during the pandemic. Although citation density declined after 2022, this trend may be attributed to the increasing number of new publications diluting average citations. Nevertheless, the substantial citation counts highlight the enduring significance of this research area.

Figure 3. Average Citation Per Year of Sample Papers



*TC: Total Citation

Source: Authors' own drawing

Most Relevant Sources

Table 1 lists the top ten sources where papers were published. The "ACM International Conference Proceeding Series" leads with four papers, indicating the prominence of conference proceedings in disseminating cutting-edge findings. Journals like "CMC-Computers Materials & Continua" and

"Computational Intelligence and Neuroscience" each contributed three papers, showcasing the interdisciplinary nature of the research. Additionally, the presence of sources like "Frontiers in Sustainable Food Systems" emphasizes the practical implications of blockchain in enhancing food logistics and sustainability.

Table 1. Top Ten of the Most Relevant Sources among Sample Papers

Sources	Papers
1 ACM International Conference Proceeding Series	4
2 CMC-Computers Materials & Continua	3
3 Computational Intelligence and Neuroscience	3
4 Lecture Notes in Networks and Systems	3
5 5th International Conference on Universal Village, UV 2020	2
6 Communications In Computer and Information Science	2
7 Expert Systems with Applications	2
8 Food And Machinery	2
9 Frontiers In Sustainable Food Systems	2
10 Heliyon	2

Most Influential Sources

Table 2 highlights the most impactful sources, ranked by metrics such as h-index and total citations.

"Journal of Cleaner Production" stands out with 152 citations, reflecting its influence in promoting sustainable practices. Similarly, "Expert Systems with

Applications" and "Heliyon" are notable contributors, with their focus on advanced technologies and practical applications in logistics. These sources underscore the cross-disciplinary appeal of blockchain research, blending insights from technology, logistics, and environmental sustainability.

Table 2. Top Ten of the Most Impactful Sources among Sample Papers

Element	h_index	TC	NP	PY_start
Computational Intelligence and Neuroscience	2	21	3	2022
Expert Systems with Applications	2	49	2	2021
Food And Machinery	2	9	2	2021
Heliyon	2	29	2	2023
Journal Of Cleaner Production	2	152	2	2021
2019 IFIP/IEEE Symposium on Integrated Network and Service Management, IM2019	1	24	1	2019
2020 11th International Conference on Computing, Communication and Networking Technologies, ICCCNT 2020	1	14	1	2020
2020 IEEE International Conference on Pervasive Computing and Communications Workshops, Percom Workshops 2020	1	12	1	2020
2023 International Conference on Intelligent Computing, Communication, Networking and Services, ICCNS2023	1	2	1	2023
2nd IEEE International Conference on Distributed Computing And Electrical Circuits And Electronics, ICDCECE 2023	1	2	1	2023

Most Impactful Documents

Table 3 identifies the top ten globally cited papers, with "Sunny et al. (2020)" leading at 241 citations. This paper's significant impact stems from its focus on blockchain's role in enhancing supply chain

transparency. The second-ranked paper by "Han et al. (2021)" and others in the list demonstrate the diversity of blockchain applications across sectors like food safety, pharmaceuticals, and logistics. These influential works provide foundational knowledge and inspire subsequent studies in the field.

Table 3. Top Ten Globally Cited Documents among Sample Papers

Paper	DOI	Total Citations
Sunny et al., 2020, Comput Ind Eng	10.1016/j.cie.2020.106895	241
Han et al., 2021, Trends Food Sci Technol	10.1016/j.tifs.2021.01.066	190
Bamakan et al., 2021, J Clean Prod	10.1016/j.jclepro.2021.127021	132
Baralla et al., 2021, Concurr Comput-Pract Exp	10.1002/cpe.5857	68
Masudin et al., 2021, Global J Flexible Syst Manage	10.1007/s40171-021-00281-x	50
Qian et al., 2022, Food Control	10.1016/j.foodcont.2022.108940	40
Yan et al., 2020, Proc Acm Sigmod Int Conf Manage Data	10.1145/3318464.3386127	40
Yadav & Kumar, 2023, Int J Prod Econ	10.1016/j.ijpe.2022.108716	39
Badhotiya et al., 2021, Mater Today Proc	10.1016/j.matpr.2021.01.673	38
Singh et al., 2023, Multimed Tools Appl	10.1007/s11042-022-14006-4	35

Social Structure and Collaboration Networks

One of the defining characteristics of scientific research is the extent to which it is conducted in collaboration with researchers in other countries (Matveeva et al., 2022). The nature of scientific research is evolving in such a way that it is becoming increasingly collaborative. The application of bibliometric techniques represents an efficacious and unobtrusive methodology for the analysis and comprehension of collaboration within the domain

of scientific research (Subramanyam, 1983). Table 4 and Figure 4 demonstrate the prevalence of international collaboration as evidenced by a sample of papers.

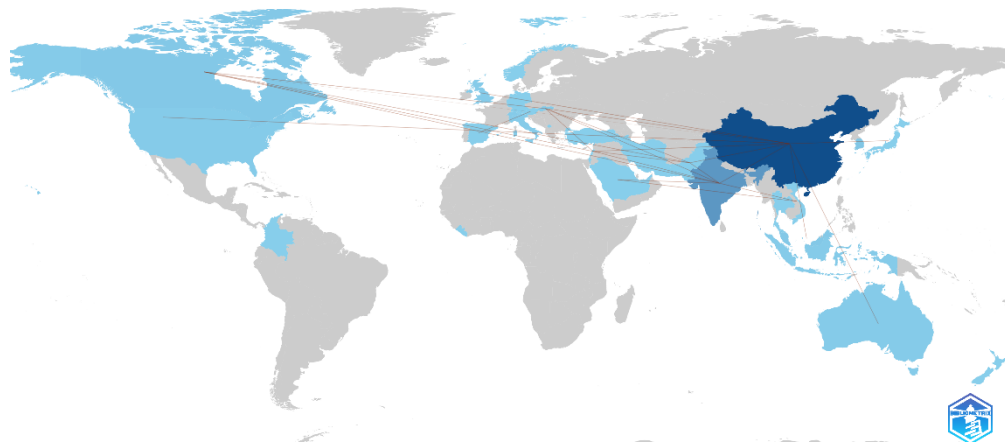
Collaboration networks, detailed in Table 4 and visualized in Figure 4, reveal the central role of China and Canada in advancing blockchain research in cold chain logistics. China's frequent collaborations, particularly with Canada, underscore its leadership in technological innovation. Meanwhile, Canada's

diverse partnerships with countries like Slovakia, Pakistan, and Lebanon highlight its active role in fostering global academic cooperation. Such collaborations are essential for addressing regional disparities and promoting inclusive advancements in cold chain logistics.

Table 4. Collaboration Networks between Countries in Sample Papers

From	To	Frequency	From	To	Frequency
Canada	Lebanon	1	China	Usa	1
Canada	Pakistan	1	India	Canada	1
Canada	Slovakia	1	India	Lebanon	1
China	Australia	1	India	Pakistan	1
China	Canada	3	India	Saudi Arabia	1
China	India	1	India	Slovakia	1
China	Japan	1	India	Vietnam	1
China	Lebanon	1	Lebanon	Pakistan	1
China	Malaysia	1	Lebanon	Slovakia	1
China	Pakistan	1	Pakistan	Slovakia	1
China	Slovakia	1	Saudi Arabia	Vietnam	1
China	United Kingdom	1	Spain	Austria	1

Figure 4. Countries' Collaboration World Map



Country Citation Rankings

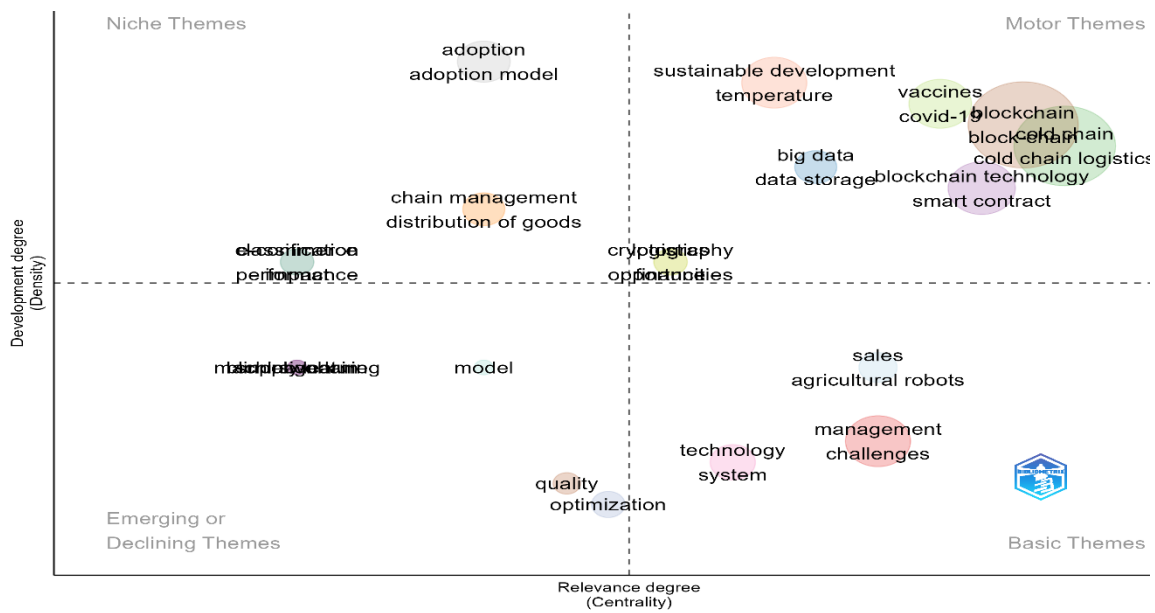
Table 5 ranks countries based on total and average citations per paper. China leads with 437 total citations, reflecting its extensive research output and influence. Interestingly, Iran achieves the highest

average citations per paper at 132, indicating the exceptional impact of its contributions despite a lower publication volume. These metrics underscore the global nature of blockchain research and the varying levels of academic impact across regions.

Table 5. Citation Rankings of Leading Countries

Country	Total Citation	Average Paper Citations
China	437	10.40
India	364	26.00
Iran	132	132.00
Italy	68	68.00
Indonesia	58	29.00
Korea	49	12.20
Vietnam	35	35.00
U Arab Emirates	26	26.00
Spain	19	19.00
Germany	18	18.00
United Kingdom	14	14.00
Lebanon	12	12.00
Israel	9	9.00
Singapore	9	9.00

Figure 7. The Thematic Mapping of the Most-Frequently Appeared Keywords



Thematic Evolution

Figure 8 illustrates the results of the analysis of the thematic evolution of papers on blockchain technology in cold chain logistics, based on author keywords. Thematic evolution can be analysed with

regard to specific time intervals, which enables the identification of instances where topics merge or divide into several themes. Such graphs are a valuable tool for visualising the thematic evolution of a research area (Aria et al., 2022).

Figure 8. The Thematic Evaluation of Keywords

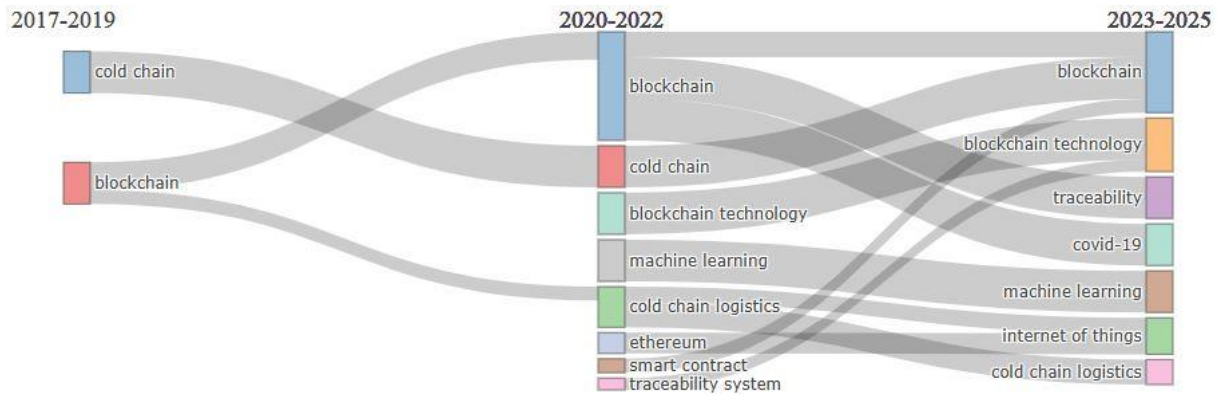


Figure 8 captures the thematic evolution across three distinct time periods: 2017–2019, 2020–2022, and 2023–2025. During the initial period (2017–2019), foundational terms like "cold chain" and "blockchain" dominated the research, reflecting the nascent stage of the field. In the second period (2020–2022), themes such as "machine learning," "smart contracts," and "Ethereum" emerged, showcasing the increasing incorporation of advanced technologies.

These visualizations collectively demonstrate the dynamic nature of this research domain, highlighting established themes, identifying areas for future

The COVID-19 pandemic significantly influenced research during this time, as seen in the heightened focus on "traceability systems" and "vaccine logistics." In the latest period (2023–2025), terms like "IoT," "traceability," and "COVID-19" remain prominent, emphasizing the ongoing importance of transparency, real-time monitoring, and global health challenges in shaping blockchain applications in cold chain logistics.

exploration, and showcasing how external factors like the pandemic have influenced the evolution of blockchain in cold chain logistics.

By examining these data visualizations and analyses, the study provides a comprehensive understanding of the academic landscape, identifying both established trends and emerging opportunities in blockchain research for cold chain logistics.

Co-citation Analysis

The co-citation analysis provides insights into the interconnectedness of academic studies based on shared citations, facilitating the exploration of thematic relationships within the literature (Niknejad et al., 2021). Citation analysis is a prominent methodology in bibliometrics, employing citation counts to evaluate similarities between documents, authors, or journals. Co-citation analysis is typically employed to map older research, offering a dynamic, forward-looking perspective that is most effective when applied across different time periods (Aria & Cuccurullo, 2017). The process of elucidating the structure of the literature and identifying connections between a multitude of academic studies based on references is made possible by means of co-citation analysis (Zitt & Bassecoulard, 1994; Özcan Akdağ & Tunca, 2022).

Table 6 presents the results of this analysis, which was conducted using the Bibliometrix package in R. The analysis identified a network of 20 highly cited papers, categorized into four distinct clusters. These clusters, defined by their thematic focus, represent the structural relationships and evolution of research within the analyzed field.

The chronological distribution of studies in the network highlights the historical progression of research. The earliest study in the dataset, published in 2009, is found in Cluster 1, indicating the foundational nature of this work within its thematic

grouping. Conversely, the most recent publication, from 2023, is part of Cluster 4, reflecting the emergence of contemporary research themes. These temporal markers underscore the dynamic nature of scholarly inquiry, with older clusters providing a basis for subsequent developments and newer clusters introducing fresh perspectives.

The analysis revealed that Cluster 2 contains the largest number of studies, with 10 papers. This indicates a significant concentration of research activity and scholarly interest within this thematic area, potentially suggesting its central importance to the overall field. The remaining clusters have fewer papers but contribute unique thematic insights, demonstrating the diversity of research approaches and focuses represented in the network.

Table 6 also includes key centrality metrics such as Closeness, Betweenness, and PageRank, which quantify the importance of nodes (papers) within the network. Closeness centrality measures the average distance of a node to all other nodes, indicating its accessibility within the network. A node with high closeness centrality is strategically positioned to influence or be influenced by others efficiently. Betweenness centrality identifies nodes that act as bridges between different parts of the network, highlighting their role in facilitating connections between otherwise disconnected nodes (Zhang & Luo, 2017). PageRank, a pivotal metric, assesses the relative importance of nodes based on the structure of the network, reflecting their influence on the overall scholarly discourse (Zhang et al., 2022). Together, these metrics provide a comprehensive understanding of the roles and significance of individual studies within the co-citation network.

Table 6. Co-citation Analysis of Sample Papers' References

Vertex	Cluster	Betweenness Centrality	Closeness Centrality	Pagerank Centrality
behnke k 2020	1	37.1484848	0.03448276	0.05724801
abad e 2009	1	12.7418895	0.02857143	0.06427814
badia-melis r 2018	1	3.9325312	0.03030303	0.05652608
tian f 2017	2	0.2588235	0.02631579	0.06442054
feng hh 2020-1	2	0.2000000	0.02439024	0.08843080
caro miguel 2018	2	8.7901070	0.03125000	0.05443955
galvez jf 2018	2	4.5474450	0.03030303	0.07162763
kamilaris a 2019	2	2.4686275	0.02500000	0.05642492
bumblauskas d 2020	2	1.3661319	0.02631579	0.06928293
salah k 2019	2	0.7500000	0.02631579	0.05649924
george rv 2019	2	2.2939097	0.02631579	0.05668469
hobbs je 2020	2	23.5650030	0.03225806	0.03348812
kamble ss 2020-1	2	19.5836898	0.03571429	0.05460337
bamakan smh 2021-1	3	7.6322638	0.02941176	0.03669057
dutta p 2020	3	12.3686275	0.03225806	0.03916807
saberi s 2019	3	3.8446227	0.02857143	0.03105663
kumar a 2021	3	2.2203803	0.02777778	0.02412371
anand s 2022	4	0.2000000	0.02272727	0.02833567
hadipour-rokni r 2023	4	0.2000000	0.02272727	0.02833567
zhang bh 2014	4	0.2000000	0.02272727	0.02833567

Figure 9. Visualization of Co-citation Network

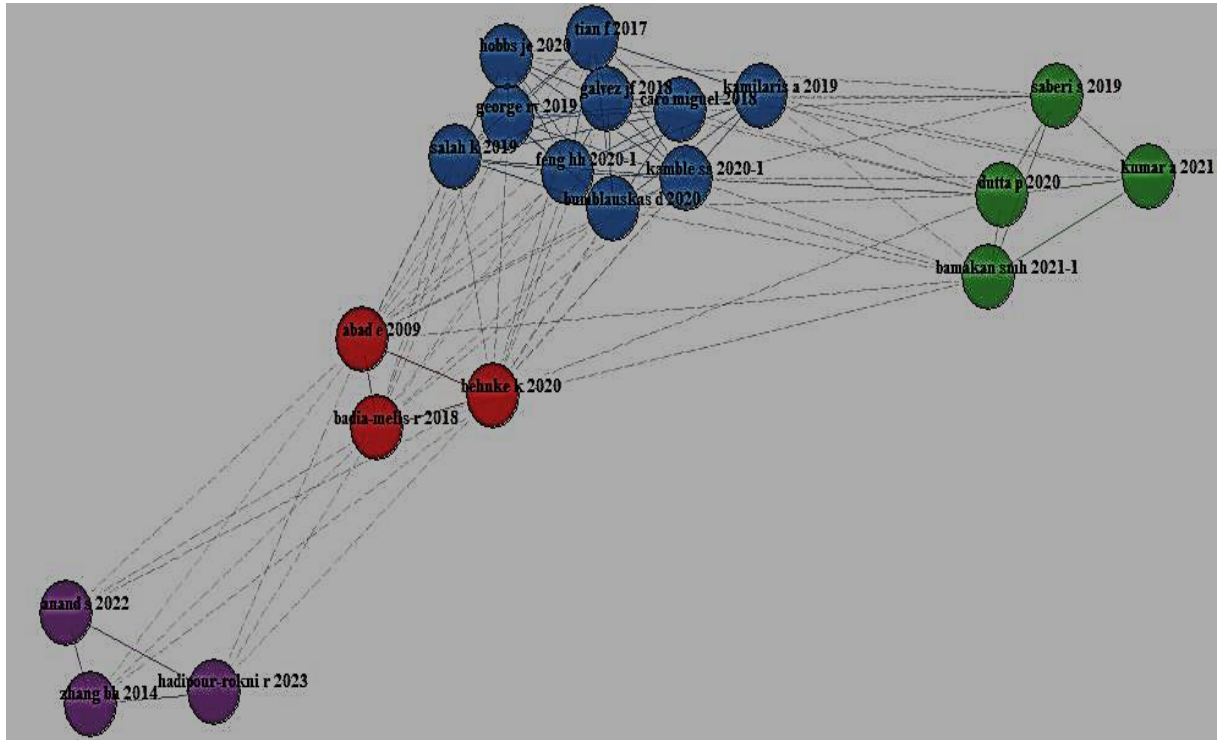


Figure 9 visualizes the co-citation network, illustrating the relationships among references based on shared citations. Each cluster is depicted using a distinct color, with red representing Cluster 1, blue Cluster 2, green Cluster 3, and purple Cluster 4. The visualization reveals the dense connections within the network, highlighting the centrality of specific papers and their pivotal roles in shaping the field. The clustering further demonstrates how research themes evolve and diverge over time, with nodes

(representing individual papers) connected by lines that signify shared citations. The varying density of connections within and across clusters reflects the relative influence of papers and the thematic cohesion of the clusters.

This analysis underscores the utility of co-citation analysis as a method for mapping the intellectual structure of a research field. By examining the relationships between highly cited works, it is possible to identify influential studies, understand

the thematic evolution of research, and uncover the dynamics of scholarly discourse over time.

5. CONCLUSION

The growing complexity of global supply chains, coupled with the rising demand for transparency and reliability, has underscored the importance of innovative technologies in addressing logistical challenges. Cold chain logistics, in particular, plays a crucial role in ensuring the quality and safety of temperature-sensitive products such as vaccines, pharmaceuticals, and perishable food items. However, the susceptibility of cold chains to disruptions, inefficiencies, and fraud necessitates solutions that can enhance traceability, transparency, and operational efficiency. Blockchain technology has emerged as a promising tool to address these issues by enabling decentralized, secure, and tamper-proof data management across supply chains (Hofmann et al., 2017; Bamakan et al., 2021). Its integration with complementary technologies such as the Internet of Things (IoT) and artificial intelligence has further amplified its potential to revolutionize cold chain logistics (Cil et al., 2022; Shashi et al., 2018; Jiang et al., 2024).

This study provides a comprehensive analysis of the academic literature on blockchain applications in cold chain logistics, offering valuable insights into emerging themes, collaboration patterns, and research gaps. By employing bibliometric and co-citation methods, the research maps the intellectual structure of this rapidly evolving field. The analysis of 112 peer-reviewed papers retrieved from Scopus and Web of Science reveals key findings that enhance our understanding of blockchain's role in addressing challenges within cold chain logistics.

One of the major findings of this study is the significant surge in research interest following the COVID-19 pandemic. This increase reflects a global recognition of the need for resilient and transparent cold chain systems, particularly for the distribution of vaccines and temperature-sensitive pharmaceuticals. Blockchain's potential to ensure traceability, prevent fraud, and enhance accountability has driven its growing adoption in logistics systems worldwide (Mustafa et al., 2024;

Jiang et al., 2024). The thematic analysis identifies dominant research areas, such as the integration of blockchain with IoT and machine learning, which enable real-time monitoring and predictive analytics (Badia-Melis et al., 2018; Rane et al., 2024). These advancements are particularly relevant for cold chains, where maintaining optimal temperature conditions is critical to ensuring product quality and safety.

Another important finding of this study is the identification of global collaboration patterns. The analysis highlights China and Canada as leading contributors to blockchain research in cold chain logistics, reflecting their investments in technological innovation and academic partnerships (Ramírez et al., 2022). However, the study also reveals significant regional disparities, with limited contributions from developing regions such as Africa and South America. These findings point to untapped opportunities for future research and collaboration, particularly in regions where cold chain systems are critical for food security and public health.

In terms of contributions to the literature, this study advances our understanding of blockchain's role in cold chain logistics by providing a systematic synthesis of the existing research. It identifies key trends and thematic areas, offering a structured overview of the current knowledge base. This synthesis not only highlights what is currently known but also uncovers critical gaps in the literature. For example, while significant progress has been made in understanding blockchain's technical capabilities, limited research has explored its scalability, cost-effectiveness, and implementation challenges. These issues are particularly relevant for small and medium-sized enterprises (SMEs) and developing economies, where resource constraints may hinder blockchain adoption (Si, 2022; Mustafa et al., 2024).

The practical implications of this study are equally significant. For industry practitioners, the findings underscore the potential of blockchain technology to optimize cold chain logistics by improving transparency, traceability, and operational efficiency.

Blockchain, when integrated with IoT and other advanced technologies, can enable real-time monitoring of temperature-sensitive goods, reducing the risk of spoilage and losses (Halim et al., 2021; Cil et al., 2022). This has important implications for sectors such as healthcare, pharmaceuticals, and food logistics, where product integrity is paramount. For policymakers, the study highlights the need for standardized blockchain protocols and regulatory frameworks to facilitate global adoption and interoperability (Shen et al., 2022; Zhang et al., 2022).

While this study makes important contributions, it also has certain limitations that should be acknowledged. First, the analysis is limited to peer-reviewed papers retrieved from Scopus and Web of Science, which may exclude relevant gray literature and industry reports. Second, the focus on English-language publications may result in a bias towards research conducted in English-speaking countries. Future studies could address these limitations by incorporating a broader range of sources and languages to provide a more comprehensive analysis.

Building on the findings of this study, several opportunities for future research emerge. First, future studies should explore the scalability and cost-effectiveness of blockchain technologies in cold chain logistics, particularly in resource-constrained settings. Research focusing on implementation challenges, such as interoperability, cybersecurity, and regulatory barriers, would provide valuable insights for both academics and practitioners. Second, interdisciplinary research that combines blockchain with other emerging technologies, such as artificial intelligence, big data analytics, and robotics, holds significant potential to drive innovation in cold chain systems (Hofmann et al., 2017). Third, there is a need for region-specific studies to address the unique challenges faced by developing economies, where cold chain infrastructure is often underdeveloped.

In conclusion, this study provides a structured and comprehensive analysis of blockchain research in cold chain logistics, contributing to both theory and practice. By uncovering thematic trends, collaboration networks, and research gaps, the study

offers valuable insights for academics, practitioners, and policymakers. The findings highlight blockchain's potential to address critical challenges in cold chain logistics, particularly in ensuring transparency, traceability, and efficiency. As global supply chains continue to evolve, blockchain technology will play an increasingly important role in building resilient and sustainable logistics systems. Future research that addresses scalability, implementation challenges, and cross-regional collaboration will be essential to fully unlock the transformative potential of blockchain in cold chain logistics.

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