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A Comprehensive Bibliometric Study of Digital Leadership Influence on Technopreneurial Success

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ABSTRACT

This study investigates the role of digital leadership in fostering technopreneurship in Indonesia, a rapidly evolving sector shaped by technological advancements and digital transformation. As technological innovation and data-driven decision-making are central to the success of technopreneurs, understanding the role of leadership in this context is critical for sustainable growth. The primary aim of this research is to explore how digital leadership can enhance technopreneurship in Indonesia by promoting collaboration, innovation, and operational efficiency. The **method** a literature review and bibliometric analysis are employed to identify key trends and research patterns in digital leadership and its impact on the technopreneurship ecosystem. By analyzing data from various sources, the study provides an in-depth examination of the current state of the field. This **research contributes** a unique perspective by combining bibliometric analysis with traditional literature review, providing a comprehensive, data-driven approach to understanding how digital leadership drives technological innovation. It also emphasizes the challenges technopreneurs face, such as the digital skills gap and regulatory barriers, areas often overlooked in previous studies. While previous research has explored the general impact of digital leadership on business transformation, this study fills the **gap** by specifically focusing on Indonesia technopreneurship ecosystem and its unique challenges. The **findings** confirm that digital leadership plays a pivotal role in overcoming obstacles like unequal access to technology and driving innovation in technopreneurship. The study recommends strategies such as enhancing digital skills, investing in infrastructure, and fostering more flexible regulations to support the growth of technopreneurship in Indonesia.

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1. INTRODUCTION

Technological advancements have brought significant changes to the global business landscape, including in Indonesia, where rapid developments in information technology, communication, and automation have fueled the emergence of technopreneurship, which focuses on technological innovation [1]. In this dy-

namic environment, digital leadership has become a crucial element determining the success or failure of technopreneurship [2]. The ability of leaders to effectively use digital technologies to drive business goals and foster innovation plays a vital role in the development of technology-based enterprises, especially in emerging economies like Indonesia [3]. As the digital economy grows, the role of digital leadership becomes more central to shaping business success in technology-driven sectors [4].

This research aims to explore the role of digital leadership in supporting the growth of technopreneurship in Indonesia, a country currently experiencing a phase of significant growth in this sector [5]. Technopreneurship has become a core pillar of Indonesia technology-driven economic development, fueled by the rise of tech startups such as Gojek, Tokopedia, Bukalapak, and Traveloka [6]. These startups have created new job opportunities and strengthened Indonesia global competitiveness, playing a pivotal role in the ongoing transformation of the digital economy [7].

The study combines a literature review with bibliometric analysis to present a comprehensive, data-driven perspective on the relationship between digital leadership and technopreneurship in Indonesia [8]. The method used in this study allows for the visualization and quantification of trends and connections between these elements, utilizing citation analysis and research network visualizations [9]. The novelty of this study lies in its ability to visually map and quantify the growing trends and connections between these two elements through citation analysis and research network visualizations, an approach that previous studies have not fully explored [10].

Despite the rapid growth of technopreneurship in Indonesia, challenges such as low technology adoption in underdeveloped areas, limited access to funding for tech startups, and gaps in education and digital skills remain prevalent [11]. The gap in research on how digital leadership specifically affects this sector in Indonesia is significant [12, 13].

As technopreneurship continues to expand, digital leadership will play an increasingly vital role in directing technological change, resource management, and innovation strategies [14]. This study highlights the importance of digital leadership in fostering a conducive environment for technopreneurship to thrive, providing insights that can also be applied to other emerging economies facing similar challenges related to technological infrastructure, funding, and digital literacy [15]. By addressing the gap identified, Indonesia and other countries can leverage digital leadership to create a more robust and sustainable technopreneurial ecosystem [16].

2. RESEARCH METHODOLOGY

Bibliometric analysis is a literature review with bibliometric analysis to present a comprehensive, data-driven perspective on the relationship between digital leadership and technopreneurship in Indonesia [17]. Researchers study the content of bibliographies and analyze citations of articles published in journals and other scientific papers [18]. In this implementation, bibliometric analysis is also often assisted by VOSViewers software in analyzing data [19]. VOSViewer is known as one of the computer tools that can be used to display bibliometric maps [17].

Emphasize the novel approach of combining bibliometric analysis with a literature review, a method that has not been widely applied in previous studies on digital leadership and technopreneurship. This dual approach enhances the depth of the analysis [20, 21]. It provides a unique visual representation of research trends and networks, offering new insights into the relationship between digital leadership and technopreneurship in Indonesia [22, 23].

To fill this gap, bibliometric analysis can provide in depth insights into research trends, citation patterns, and collaboration networks related to digital leadership and technopreneurship topics [24].

The use of both literature review and bibliometric analysis adds a novel methodological approach that not only provides depth but also visualizes research trends, emphasizing Indonesia rapidly growing digital market as highly timely and relevant [25]. This approach is carried out to identify and analyze relevant research related to digital leadership and technopreneurship. Steps taken in the literature review include:

- Literature searches were conducted using academic databases such as Google Scholar, Scopus, and IEEE Xplore, employing keywords like ”digital leadership”, ”technopreneurship”, and ”Indonesia” [26].

- Literature Selection: Articles selected based on relevance, year of publication (within the last 10 years), and quality of publication. Only peer-reviewed literature is considered [27].

- Literacy Synthesis: Relevant articles are classified based on key themes such as technological innovation, data-driven decision-making, digital transformation, and the technopreneurship ecosystem [28].

Figure 1. SDGs 8 and 9 focus on fostering sustainable economic growth

The Figure 1 bibliometric analysis highlights that digital leadership is not only integral to fostering technological innovation and digital transformation but also to advancing sustainable development [29]. Digital leaders contribute to SDG Goal 9 by promoting infrastructure development and leading the digital transformation of industries [13, 20]. Additionally, by driving data driven decision-making, they help create smarter, more efficient solutions that align with SDG Goal 8, which focuses on fostering sustainable economic growth and employment [30]. These elements are vital in ensuring that technopreneurship remains an important engine for economic development [31, 32]. Bibliometric analysis is used to analyze research trends quantitatively [33]. This analysis includes:

- Data Collection, bibliometric data was obtained from the Scopus and Web of Science databases using the same keywords as in the literature review.
- Citation Analysis, use software such as VOSviewer or Biblioshiny to analyze citation patterns, researcher collaboration, and a network of topics that often arise in related research.
- Network Visualization, the results of the bibliometric analysis are visualized in the form of citation networks and co-authorship networks to show the relationship between the topic and the researchers involved.

These articles have contributed significantly to understanding the intersection of digital leadership and technopreneurship, with many discussing frameworks that guide innovation, technology adoption, and leadership strategies [34]. By recognizing these highly cited sources, the study reinforces its position in the ongoing discourse on how digital leadership can be applied to support technopreneurship in Indonesia and globally [35].

3. RESULT AND DISCUSSION

Article search using publish or perish software. As stated the first principle of the bibliometric analysis method is to determine keywords, and the second principle is keyword search [36]. Based on these principles, the determination of research keywords as listed in Figure 2, namely ”Digital leadership Entrepreneurship through the title column, the maximum number of publications is 500 articles and limits the range of publications from 2019 to 2024. Based on articles obtained from keyword searches, according to the Google Scholar

database, 393 articles related to ”Digital Leadership Entrepreneurship” [37]. Furthermore, the researcher saves the data from this search in CSV format which is then processed using Microsoft Excel and the RIS format used in the VOSViewer application [38].

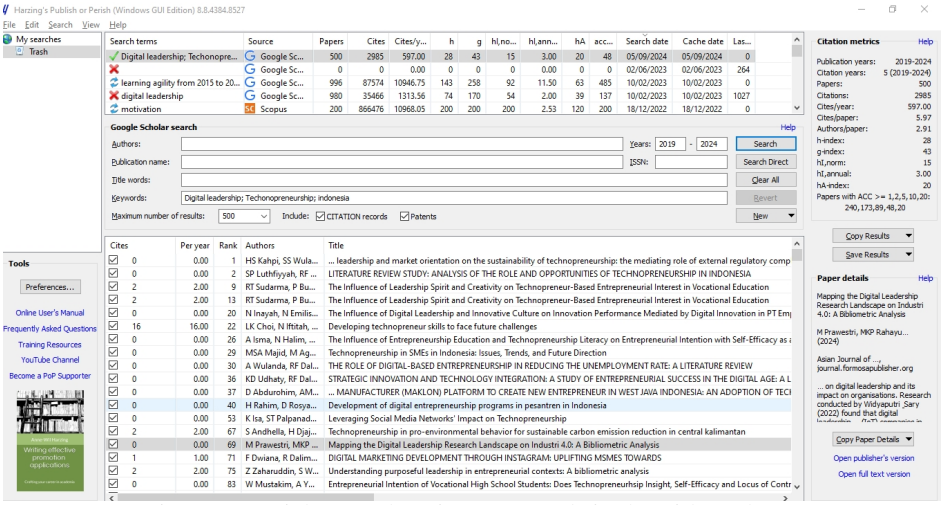

Figure 2. Article Search Using Keywords in the Title Column

According to the data collected in Table 1, there are 9 articles with the highest number of citations. The total number of citations for all the papers used in this study is 1658. The average number of citations per year is 331.60, and the average number of citations per article is 8.29. The average number of authors per article is 111.69. The H-index for all articles is 22, and the G-index is 34.

Table 1 to ensure that all data are properly aligned, making it easier to read and more visually appealing [39, 40]. This change enhances the presentation of the information, ensuring that the citation counts, authors, and titles are clearly distinguished and accessible to the reader.

Table 1. Most Cited Articles from 2019-2024

Author	Title	Year	Quote
K Okundaye, SK Fan, RJ Dwyer	Impact of information and communication technology in Nigerian small-to-medium-sized enterprises	2019	236
RNN Naseri	Issues And Challenges Of Online Shoppingactivities on The Impact Of Corona Pandemic: A Study On Malaysia Retail Industry	2021	104
D Suprayitno	Analysis Of Customer Purchase Interest in Digital Marketing Content	2024	85
MS Shahriar, KM Islam, NM Zayed	The impact of COVID-19 on Bangladesh economy: A focus on graduate employability	2021	83
AS Bist, V Agarwal, Q Aini	Managing Digital Transformation in Marketing: ”Fusion of Traditional Marketing and Digital Marketing”	2022	75
M Qorib, A Afandi	Implementing prophetic values in the islamic life guidelines for Muhammadiyah Citizens: A Qualitative Analysis For Transforming	2024	72
P Datta, JK Nwankpa	Digital transformation and the COVID-19 crisis continuity planning	2021	69
Z Lubis, M Zarlis, MR Aulia	Performance analysis of oil palm companies based on barcode system through fit viability approach: Long work as a moderator variable	2023	59
A Dudhat, NPL Santoso, S Santoso	Blockchain in Indonesia University: A Design Viewboard of Digital Technology Education	2021	53

The data in Table 1 explains how the average number of citations, H-index, and G-index are relevant to understanding the impact of the most cited articles in the field of digital leadership and technopreneurship [41, 42]. These highly cited papers not only reflect the prevailing trends and priorities in the field but also contribute foundational knowledge that supports the current study findings. For example, articles with high citation counts indicate a broad consensus on the importance of digital leadership in fostering innovation, which directly correlates with the study focus on technopreneurship in Indonesia. Furthermore, the researcher determined the visualization of the article obtained through Publish or Perish using VOSViewer software [39]. In the analysis, the number of computational mappings found was 78 words/terms. Every item found is related to digital leadership technopreneurship in data mapping is divided into 5 clusters, as follows:

- Cluster 1 which is marked in red has 11 words/terms, namely Behavior, Culture, digital, digital age, digital leadership, employee performance, leader, leadership, organization, quality, relationship.
- Cluster 2 which is marked in green has 10 words/terms, namely Competency, digital economy, economy, growth, human resource, medium enterprise, msmes, smes, startup, sustainability.
- Cluster 3 which is marked in blue has 8 words/terms, namely ability, digital marketing, e-commerce, effectiveness, higher education, information, problem, and work.
- Cluster 4 which is marked with light green has 7 words/terms, namely challenges, creativity, entrepreneurship education, person, technopreneur, unemployment, and vocational education.
- Cluster 5 which is marked with purple has 3 words/terms, namely knowledge, self efficacy, and transformational leadership.

The connections between terms are shown within each cluster. Each term is represented by a colored circle, with the size of the circle reflecting the frequency of its occurrence. Larger circles indicate more frequent appearances of the term in titles or abstracts. The visualization in this study is divided into three sections:

1. Network visualization shown in Figure 2
2. Density visualization shown in Figure 3
3. Overlay visualization shown in Figure 4

The study includes visual representations of the data, with different types of visualizations presented in various figures. Illustrates the network visualization, providing a clear overview of the connections and relationships within the dataset. The density visualization, offering insight into the distribution and concentration of the data points. Finally, Features the overlay visualization, combining the previous visualizations to give a comprehensive view of the dataset structure and patterns.

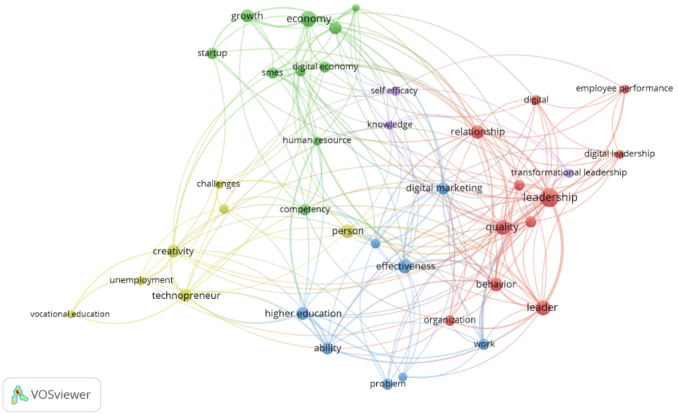

Figure 3. Network Visualization

The network visualization in Figure 3 shows a coherent relationship between terms, organized into five clusters, red (group 1), green (group 2), blue (group 3), light green (group 4), and purple (group 5). These clusters represent terms frequently researched and related to the study topic.

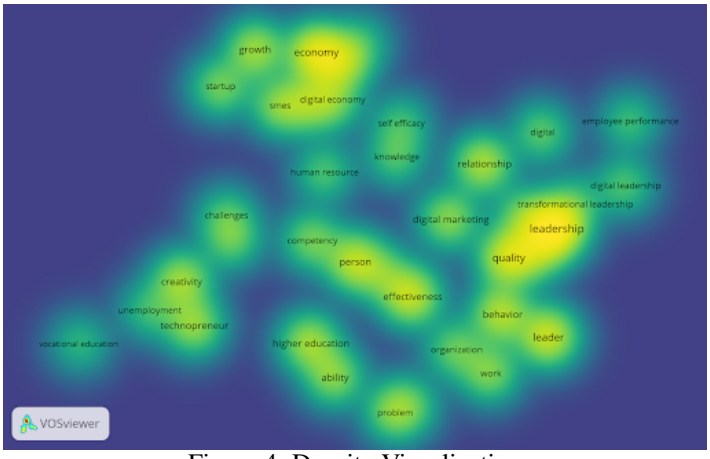

Figure 4. Density Visualization

The results of the density visualization Figure 4 show that the term appears more often when the term label has a larger diameter and a brighter yellow color. Conversely, if the yellow color fades, it means that the number of people researching the term is small. Referring to the results of density visualization, it can be seen that research related to the term leadership has many types of research [43, 44].

Conversely, the fading yellow color indicates terms that are less frequently researched, with a smaller diameter suggesting a lower volume of studies associated with those terms. For example, terms like ”vocational education”, ”unemployment”, and ”creativity” show smaller labels in the density map. This color coded display helps to quickly identify which topics have a significant body of research and which may be under-explored or emerging [45].

Referring to the results of this Density Visualization, it becomes evident that leadership-related topics, particularly ”leadership”, ”digital leadership”, and ”transformational leadership”, are among the most researched in the field. These terms, being larger and highlighted with brighter yellow tones, suggest a high level of academic interest and research activity [46, 47].

This data driven approach offers valuable insights into the current trends in leadership studies, underlining the growing importance of digital and transformational leadership in modern organizational environments.

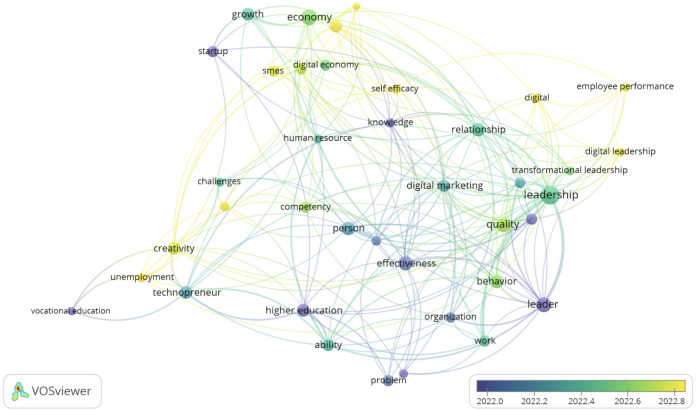

Figure 5. Overlay Visualization

According to Figure 5, which shows an overlay representation, the hue variation for each year shows the year range of publication. The purple grid represents the earliest year of publication, while the yellow grid

represents the most recent year of publication [48]. Based on the results of the data mapping of the collected articles, it can be seen that the keyword leadership has been used quite a lot in research in Indonesia. Therefore, it is necessary to look for more up-to-date research topics on leadership [18, 49].

The results of the literature review show that digital leadership plays a central role in supporting the development of technopreneurship through several key aspects:

- Innovation and Technology, digital leaders facilitate innovation by creating a work environment that supports the development of new ideas and adopting the latest technologies such as AI, blockchain, and big data to create competitive products and services [50].
- Data Driven Decision-Making, digital leadership encourages the optimal use of data to support strategic decisions. Data-driven leaders are able to identify market trends and consumer needs more accurately, ultimately helping technopreneurs develop more successful businesses.
- Digital Transformation, digital leaders are responsible for the success of digital transformation in organizations. They are leading the shift from traditional business models to digital, as well as integrating technology into daily operations to improve the efficiency and competitiveness of technopreneur companies.
- Collaboration in the Technopreneurship Ecosystem: Digital leadership also plays an important role in creating collaborations with other stakeholders such as the government, academia, and the private sector to build an ecosystem that supports the growth of technopreneurship in Indonesia.

This study focuses on bibliometric analysis and literature review, while acknowledging the value of integrating empirical data from real-world technopreneurship case studies in Indonesia to support the theoretical insights discussed. By examining the digital skills gap and rigid regulations, this research highlights the specific challenges technopreneurs face in Indonesia. While previous studies mention these challenges briefly, this study provides a deeper understanding by using bibliometric analysis to emphasize their prevalence and impact on technopreneurship growth.

A major challenge for technopreneurs in Indonesia is the digital skills gap, as the lack of skilled human resources hinders the implementation of effective digital strategies. Additionally, limited access to technology in some regions and inflexible regulations pose further obstacles, particularly in sectors like fintech and transportation. Despite these challenges, Indonesia offers significant opportunities, including a large digital market and a growing population of internet users, which technopreneurs can leverage for growth and innovation.

- Government Support, government initiatives such as Making Indonesia 4.0 and the 1000 Startup Movement provide strong support for the technopreneurship ecosystem.
- International Collaboration, opportunities for collaboration with researchers and entrepreneurs from other countries are getting bigger, especially in the field of advanced technology and digital innovation.

Despite challenges, Indonesia offers great opportunities for technopreneurs. Government initiatives like Making Indonesia 4.0 and the 1000 Startup Movement provide crucial support. Additionally, increasing international collaboration offers valuable opportunities in advanced technology and digital innovation. With a large digital market and growing internet users, Indonesia is well-positioned to optimize these opportunities for technopreneurial growth.

4. MANAGERIAL IMPLICATIONS

To effectively navigate the rapidly changing digital landscape, managers must prioritize enhancing digital leadership skills within their teams. These skills are essential in guiding technopreneurs through digital transformation, fostering technological innovation, and making data-driven decisions. Additionally, investing in technological infrastructure is critical to enabling digital leadership and entrepreneurship, particularly in underserved regions, as it helps reduce the digital divide and supports the growth of the technopreneur ecosystem. Alongside this, promoting cross-sector collaboration is key, as it encourages partnerships between government, academia, and the private sector, fostering an innovative ecosystem that drives sustainable economic growth and global competitiveness. However, a major challenge highlighted is the digital skills gap, which managers

must address by investing in training and skill development programs. By equipping the workforce with necessary digital skills, organizations can overcome this gap while also boosting efficiency and innovation. Lastly, managers should advocate for flexible regulatory frameworks that allow for technological innovation while ensuring compliance, thus enabling businesses to stay competitive in a fast-paced digital world.

5. CONCLUSION

This study underscores the critical role of digital leadership in advancing technopreneurship in Indonesia. Digital leadership is fundamental in driving technological innovation, enabling data-driven decision-making, and fostering digital transformation, all of which are essential for the sustainable growth of technopreneurs. While challenges such as limited access to technology, digital skills gaps, and regulatory constraints remain prevalent, there are significant opportunities in Indonesia rapidly expanding digital economy. Government support, alongside the thriving market, provides a strong foundation for the growth of technopreneurship in the country. These findings suggest that digital leadership can continue to shape Indonesia economic future by nurturing innovation and encouraging cross-sector collaboration.

Moreover, the findings of this study can be applied beyond Indonesia, particularly in other emerging markets facing similar challenges. Countries like India, Brazil, and South Africa are also experiencing rapid growth in digital entrepreneurship and can benefit from adopting the study recommendations. By focusing on improving digital infrastructure, addressing digital skills gaps, and implementing more flexible regulations, these countries can foster a more conducive environment for technopreneurs. Future research could build on these findings by incorporating empirical data or case studies to further validate the theoretical insights, providing a clearer understanding of how digital leadership influences technopreneurship in practice and overcoming common challenges.

The bibliometric analysis has shown that digital leadership significantly contributes to economic growth and innovation, with citation patterns indicating widespread recognition of its importance in technopreneurship. These insights not only enhance our understanding of the role of leadership in technopreneurial success but also offer a pathway for future research and policy development. As the field grows, integrating real-world case studies into future research will be essential to solidify the practical applications of these findings, making them more actionable for policymakers, business leaders, and industry practitioners.

6. DECLARATIONS

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6.2. Author Contributions

Conceptualization: AG; Methodology: WH; Software: MP; Validation: TW, IG; Formal Analysis: SS, AG; Investigation: MP; Resources: IG; Data Curation: WH; Writing Original Draft: MP, SS; Writing Review and Editing: AG, WH; Visualization: MP. All authors AG, WH, MP, TW, IG, and SS. Have read and agreed to the published version of the manuscript.

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The data presented in this study are available on request from the corresponding author.

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6.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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