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Scientometric Analysis of Digital Transformation Maturity in Research and Development

Riski [1,*], Achmad Nurmandi [1], Muhammad Younus [1,2], Herman Lawelai [3], and Wahdania Suardi [1]

[1] Department of Government Affairs and Administration, Jusuf Kalla School of Government, Muhammadiyah University of Yogyakarta, Bantul, Yogyakarta, 55183, Indonesia
[2] Department of Product Research and Software Development, TPL Logistics Pvt Ltd, Karachi, Pakistan
[3] Department of Government Studies, Universitas Muhammadiyah Buton, Bau-Bau, Southeast Sulawesi Province, 93724, Indonesia
* Corresponding Author: riskytamiang18@gmail.com

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ABSTRACT

This study uses a scientometric approach to analyze the evolution and maturity of digital transformation in research and development (R&D) over the past decade. For this purpose, bibliometric data from the Scopus database was searched from 2015 to 2024. The resulting dataset of 495 articles was then exported in CSV format. The results showed that the evolution of digital transformation has had a major impact on research progress over the previous decade, with digital transformation maturity (DTM) emerging as an important concept in understanding how organizations and sectors adapt to technological advances. This study used scientometric analysis to explore the development and trends of DTM research over the past decade. The study then focuses more deeply on evaluating digital maturity, integrating technology in decision-making processes, and exploring specific sectors that have received relatively less attention in the existing literature from an industry perspective. The findings suggest that companies need to adopt a more systematic digital transformation strategy, optimize the use of data in management, and apply innovative technologies to improve efficiency and competitiveness.

Keywords: *Digital Maturity; Digital Transformation; Scientometric Analysis; Technology Evolution*

1. Introduction

Digital transformation has become a top priority in several sectors, including healthcare, government, education, and business. This is due to digital transformation's potential to improve operational efficiency, service quality, and user experience (Duncan et al., 2022). An organization's level of readiness and its ability to strategically adopt technology, known as digital maturity, is a critical factor in determining the success of an organization's digital transformation efforts. In contrast, the capabilities associated with digital transformation include fundamental elements such as sensing, organizing, and restructuring, which facilitate business model adaptation and improved operational performance (Yu et al., 2022).

In the past decade, there has been a marked increase in scholarly publications on digital transformation and maturity. This reflects the growing academic interest in this theme. Digitalization allows companies to adapt their products more quickly to changes that can offer more relevant and competitive solutions (Kim & Cho, 2023). Digital technology has enabled companies to introduce new and more innovative solutions. It enables fast and precise information dissemination, accelerates innovation, and allows organizations to adapt more quickly to market and technological changes (Hamalainen, 2023).

The concept of digital transformation is defined as a comprehensive change in strategy, business processes, and technology to build a business model that is more flexible, efficient, and responsive to market demands. The application of digital technology enables businesses to automate operational procedures, reduce dependence on manual processes, and improve overall productivity (D. Wang & Chen, 2022). Implementing a more effective digital transformation strategy based on robust data and comprehensive analysis is essential to meet the challenges and improve competitiveness in an increasingly competitive market. Implementing digital transformation improves the effectiveness of the digitalization process and equips each process of activities carried out with a strong foundation for success and competitiveness in the digital era (Q. Chen et al., 2022).

Digital maturity measures how local governments can apply digital technologies to advance public services and policies (Debeljak & Dečman, 2022). Digital maturity is used to describe the capacity of a city or region to utilize digital technology to improve the quality of public services. The role of digital technology in the world can explore how digital technology supports economic growth and competitiveness in the context of globalization challenges (Phan & Dinh, 2023).

Implementing digital technology requires considerable investment, including hardware and human resource capacity building[1]. In addition, uncertainty about the long-term impact of digital transformation and the absence of comprehensive policy support exacerbate the situation. The selection and application of appropriate technologies and the integrating of existing systems with new digital innovations present significant challenges that further exacerbate the transformation process (Santos et al., 2024).

While digital transformation is important in improving efficiency and competitiveness, many organizations lack a systematic and comprehensive evaluation framework to assess how digital technologies are effectively integrated into the organization's activities (Loglo, 2024). This challenge is further compounded by the complexity of integrating the various dimensions of digital transformation, including technology infrastructure, management strategy, human resource capabilities, and service innovation. It is critical to develop the digital capacity and skills of the workforce, as this is a critical element in facilitating a successful digital transformation(Teichert, 2023).

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Identifying and selecting the right governance mechanisms to align with an organization's level of digital maturity presents a significant challenge (Teichert, 2023). This is largely due to the inherent complexity of large organizations, the diversity of available resources, and the uncertainty surrounding integrating new technologies with existing governance structures. Lack of resources, including financial, technological, and digital skills, hinders fully utilizing technology (HosseiniNasab, 2024).

While digital technology has the potential to enhance learning methodologies, enrich the student experience, and facilitate collaboration, there are many challenges to implementing a comprehensive digital transformation. Key barriers include limited technological infrastructure, insufficient training in utilizing digital tools, and resistance to activities accustomed to traditional methods (Gallastegui & Ricardo Reier Forradellas, 2024). The success of digital transformation depends on the ability of institutions to overcome barriers, improve the digital competence of workers, and formulate policies and strategies that can encourage innovation in pedagogy to create more effective and relevant learning experiences in the digital era. It is important to overcome these barriers by designing solutions that can effectively integrate IoT and data encryption, enabling each government institution to fully capitalize on the opportunities presented by digital transformation while maintaining strict data security and protection standards (Paños-Castro et al., 2024).

Digital transformation encompasses many elements, including integrating new technologies, business model changes, and organizational culture transformation (Liu & Pan, 2023). Changes can profoundly affect the performance of companies, which operate in complex and multifaceted ways. The lack of comprehensive and accurate data on implementing digital technologies in these companies poses a significant challenge. While many companies may not be fully transparent about digital initiatives, adopting digital technologies tends to have a more tangible and immediate impact on the company.

Scientometric analysis constitutes a pivotal element of the study "Scientometric Analysis of the Maturity of Digital Transformation in Research Development," as it furnishes an objective perspective on the evolution and impact of digital transformation in research. Leveraging data from prominent scientific databases such as Scopus and Web of Science, scientometric analysis enables mapping research trends, identifying emerging topics, and analyzing publication patterns over the past decade. Furthermore, scientometric analysis is pivotal in measuring scientific impact through various metrics, including the number of publications, citations, and h-index. It also facilitates the identification of collaboration networks among researchers, institutions, and countries, thus offering insights into the global impact of digital transformation on the research landscape.

This study differs from previous bibliometric research on digital transformation in several key aspects. Firstly, many previous bibliometric studies have exclusively focused on publication trends and citation patterns without specifically analyzing how the concept of digital transformation maturity is evolving in research and development (R&D). Secondly, this study employs a more comprehensive scientometric approach, encompassing collaboration network analysis, thematic mapping, and an evaluation of the impact of digital transformation on global research dynamics. Whereas previous studies relied on rudimentary bibliometric analysis, such as the number of publications and citations, this study utilizes co-word analysis, institutional network analysis, and research topic mapping to understand how digital transformation contributes to the research ecosystem in greater depth.

Thirdly, the present study examines past trends, identifies research gaps, and predicts future research development directions. Using analytical tools such as VOSviewer and

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Bibliometrix, the study uncovers the relationship between concepts in digital transformation research and how the research has evolved.

This study uses a scientometric approach to analyze the evolution of digital transformation maturity in research and development (R&D) over the last decade. Specifically, the study identifies publication trends, measures scientific impact, the occurrence of frequently searched keywords, and identifies research gaps that can form the basis for future research. The results of this study are expected to provide insights for academics, policymakers, and industry to understand the role of digital transformation in the research ecosystem and to formulate more effective strategies for future research development.

2. Literature Review

2.1. Conceptual Framework of Digital Transformation Maturity

At a high level, advanced technologies such as the Internet of Things (IoT), big data, and artificial intelligence (AI) are used for optimal infrastructure management and maintenance (Lassnig et al., 2022). Effective digital transformation, guided by visionary and competent leaders, can improve overall company performance in various areas, including financial management, operational efficiency, and market competitiveness (Senadjki et al., 2024). Digital transformation spearheaded by visionary leaders has proven to improve a company's financial and competitive performance. In today's digital age, a company's ability to leverage digital technologies to improve efficiency, transparency, and collaboration in procurement is a critical factor in ensuring sustainability and competitiveness in the marketplace in a digital landscape (Herold et al., 2023).

The digital strategy dimension is a comprehensive evaluation component of an institution's approach to digital transformation (Agostino et al., 2022). It assesses the extent to which the institution has formulated a long-term plan for transformation by focusing on its capacity to develop digital innovations, aiming to increase visitor engagement. The extent to which digital technologies are adopted and integrated into business operations exerts an important influence on improving competitiveness and the success of internationalization strategies (Kolagar et al., 2022). Evidence suggests that a combination of digital service maturity and an active role in the digital ecosystem can enhance an organization's capacity to achieve success internationally.

2.2. Previous Scientometric Studies on Digitalisation

The potential of bibliometric analysis as a valuable tool for understanding research trends and identifying gaps in digital literacy research Previous scientometric studies have examined the development of digitalization in various fields, including industry, education, and public policy. Most of these studies have focussed on publication trends, citation patterns, and scientific collaborations in applying digital technologies. (Thayyib et al., 2023). For example, several studies have noted a significant increase in the number of publications related to digitalization since the beginning of the 21st century, especially after the emergence of the concept of Industry 4.0 and digital transformation in organizations. Digital transformation can help develop sustainability skills in every employee, staff in the organization and ensure they are ready to face environmental challenges (C. Wang & Si, 2023).

The analysis shows that the field is characterized by many small and medium-sized groups with minimal collaboration (Biljecki, 2016). A survey of previous scientometric research shows a tendency to use rudimentary bibliometric analyses, such as measures of publication counts and citation indices, without conducting an in-depth examination of the evolution of concepts, interrelationships between topics, and the impact of digitization on research productivity.

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Several studies have explored collaboration patterns between institutions in the digitization research domain (Y. Chen et al., 2023). These studies cannot provide a comprehensive understanding of the level of readiness and maturity of digital transformation in the global research ecosystem. Therefore, a more comprehensive scientometric approach is needed to facilitate a deeper understanding of the evolution of digital transformation in academic research, the factors that influence it, and the opportunities and challenges that arise in its implementation.

2.3. Gaps and Challenges in Digital Transformation Maturity Research

Research on digital transformation maturity reveals a range of gaps and challenges that hinder effective implementation across sectors. Considerable technology gaps are evident, with limited access to advanced technologies such as 5G, Internet of Things (IoT), and artificial intelligence (AI) hampering businesses' capacity to compete on a global scale (Prokhorova & Gureev, 2023). The absence of an integrated framework creates inconsistencies in digital maturity assessments across organizations (Marks et al., 2020).

There is a need for careful measurement in ascertaining the level of digital readiness of an enterprise to deal with the difficulties inherent in digital transformation (Babkin et al., 2022). This approach involves identifying technology gaps, analyzing business processes that have not been digitized, and evaluating the digital competencies of the workforce. A further dimension focuses on technological and strategic, cultural, and stakeholder engagement dimensions.

Digital orientation reflects an organization's strategic vision and commitment to digitalization, which is important in building the foundation for a successful digital transformation (Babkin et al., 2022). Digital maturity encompasses technological readiness, business processes, and organizational culture and is an important predictor of an organization's capacity to adapt to new technologies. Digital intensity, the extent to which digital technologies are integrated into daily operations, contributes substantially to achieving profitable financial results. Digital transformation has the potential to drive sustainability by improving resource efficiency, reducing environmental footprint, and driving sustainability-oriented business innovation (Guandalini, 2022). Digital transformation can face resistance from organizations or communities due to a lack of understanding of the sustainability benefits or concerns about its impact on employment and privacy.

The digital divide refers to ongoing limited access to technology, especially in remote areas or areas with substandard health infrastructure (Iyanna et al., 2022). he lack of digital literacy among end-users, which includes medical personnel and patients, is a major obstacle to effective technology utilization. Digital transformation strategies should be carefully tailored to fit the organizational context and environmental factors while encouraging better collaboration among internal and external entities (Nikopoulou et al., 2023).

3. Research Methodology

The methodology used in this research is based on the scientometric approach. This methodology measures and analyzes scientific literature on digital transformation and digital maturity. A systematic literature review was used to identify, analyze, and summarize related research on the relationship between digital transformation (Jardak & Ben Hamad, 2022). The aim is to provide a comprehensive understanding of research developments in digital progress and digital transformation. This will be achieved by identifying trends, publication patterns, and contributions from relevant researchers, institutions, and countries (Guandalini, 2022).

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The Scopus database was searched to ensure comprehensive and systematic collection and analysis of relevant literature, and the resulting dataset was exported in CSV format. The data was then imported into RStudio and CiteSpace applications for visualization and analysis. These tools are an integral part of the methodological framework of scientific reviews, allowing researchers to visualize patterns, map bibliometric networks, and synthesize data efficiently.

The analysis also draws on studies from the SCIEspace database, which is used to provide a more comprehensive picture of research trends relating to the maturity of digital transformation in R&D. SCIEspace was utilized to identify scientific publications, citation patterns, and global collaborations related to digitization and sustainability in research. For instance, (Parida et al., 2019) examined how digitalization can enhance sustainability in innovation and R&D processes in academics.

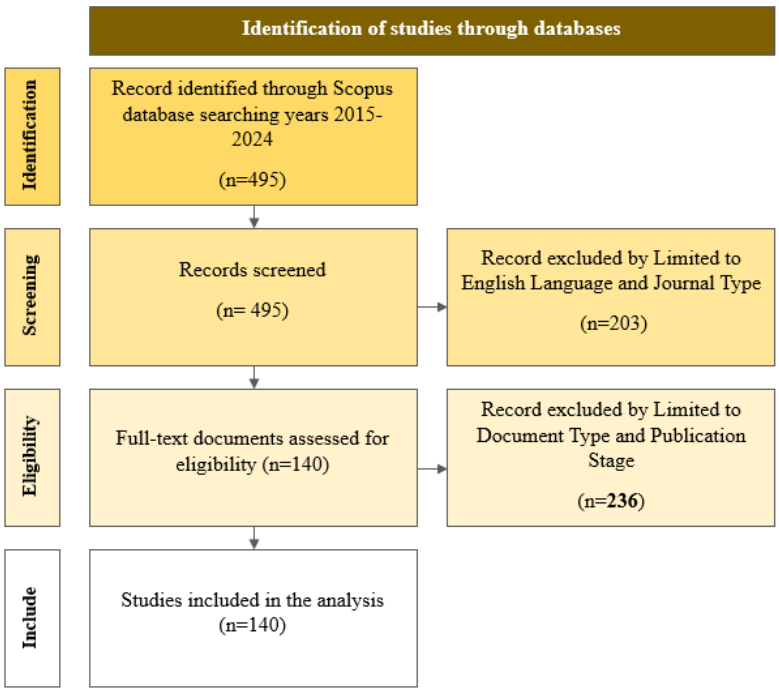

Figure 1. PRISMA Flow Diagram
Source: Data Analysis Process (2024)

The article selection process in this **Figure 1** systematic review is represented by a modified PRISMA diagram, which includes four main stages: identification, screening, eligibility, and inclusion (X. Wang et al., 2019). The identification stage was conducted by searching for articles in the Scopus database from 2015 to 2024, resulting in 495 articles. All 495 articles were reviewed in the screening stage, and 203 were excluded because they were limited to English and certain types of journals. Next, the remaining 188 articles were assessed based on their full text in the eligibility stage. At this stage, 236 articles were excluded because they did not meet the document type and publication date criteria. Finally, 140 studies met the criteria at the inclusion stage and were included in the systematic analysis. Thus, this chart clearly illustrates the systematic screening performed to ensure that only relevant and high-quality studies were analyzed.

The use of R Studio, as one of the most powerful software platforms for statistical analysis and programming, facilitates a more effective and efficient data analysis process by providing various packages and functions for collecting, cleaning, and analyzing literature data (Arifin &

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Raharja, 2023). This methodological approach is consistent with standard data collection and analysis practices in scientometric research and emphasizes the importance of visual aids in data extraction and synthesis. This study used R Studio to extract information from various academic databases, such as Scopus or Web of Science, containing publications on digital transformation and digital maturity over the last decade of research and development.

4. Results and Discussion

The number of publications reflects the level of productivity and scientific interest in a topic. Meanwhile, the map shows collaboration networks between researchers, institutions and countries and the diffusion of knowledge and innovation across the scientific community. This analysis facilitates the identification of important trends, collaborative strengths, and potential avenues for further development within a discipline.

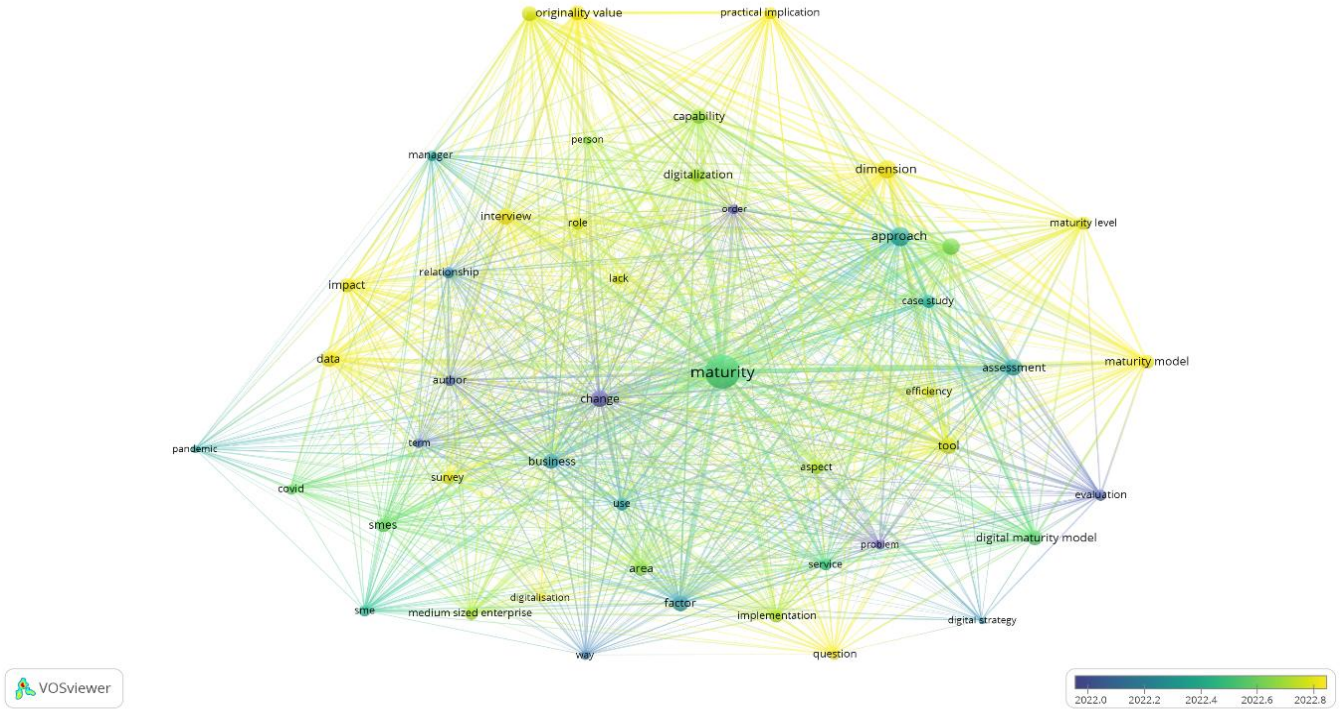

Figure 2. Keyword Co-occurrence Network
Source: Data processing from Vosviewer (2024)

Figure 2 above illustrates the keyword co-occurrence network analysis, with the keyword "maturity" at the center of the discussion. This term is closely associated with other terms such as "maturity model", "assessment", and "tool", indicating a focus on developing and evaluating digital maturity frameworks. The visualization depicts many different thematic clusters. The blue cluster, for example, includes topics related to SMEs, the pandemic, and the impact of the pandemic on digitalization. In contrast, the green cluster emphasizes digitalization, dimensionality, and efficiency, focusing on implementing digital strategies.

Furthermore, the yellow cluster reflects practical and academic contributions through keywords such as practical implications and the value of originality. The color gradient in the figure reflects temporal trends, with pandemic topics dominating early in the analysis and practical issues becoming more relevant in later periods. The strong relationships between the main keywords indicate a multidisciplinary research focus involving strategic, technological, and managerial evaluations.

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Figure 3. Topic Emergence of Digital Maturity and Digital Transformation
Source: Data processing using Rstudio (2024)

Figure 3 shows the main topics and keywords related to digital maturity and digital transformation research. The most prominent keyword is digital transformation, which indicates the main focus of research on digital transformation processes in various contexts. In addition, digital maturity and maturity models are important for measuring an organization's readiness to undergo digital transformation. Keywords such as decision-making indicate that the level of digital maturity affects decision-making effectiveness. In contrast, maturity level and hierarchical system indicate levels or structures in measuring digital readiness. Topics such as sustainable development, digital technology, and digitalization underscore the importance of digital technology in facilitating sustainable transformation. The word cloud also indicates the relevance of this topic to a wide range of organizations, including small and medium-sized enterprises (SMEs), thus illustrating that digital transformation and digital maturity are just as important for SMEs as for large organizations.

Other keywords, such as "metadata" and "information management", illustrate the importance of data and information management in this process. Meanwhile, "competition" and "sustainability" underscore the challenges and opportunities presented by digital transformation in improving organizational competitiveness and sustainability. Based on this analysis, research can focus on various aspects, including the relationship between digital maturity and decision-making effectiveness, developing sectoral maturity models, and integrating digital transformation with sustainability principles. This word cloud provides a comprehensive overview of research trends in this field while opening up opportunities for further exploration of strategic issues in digital transformation.

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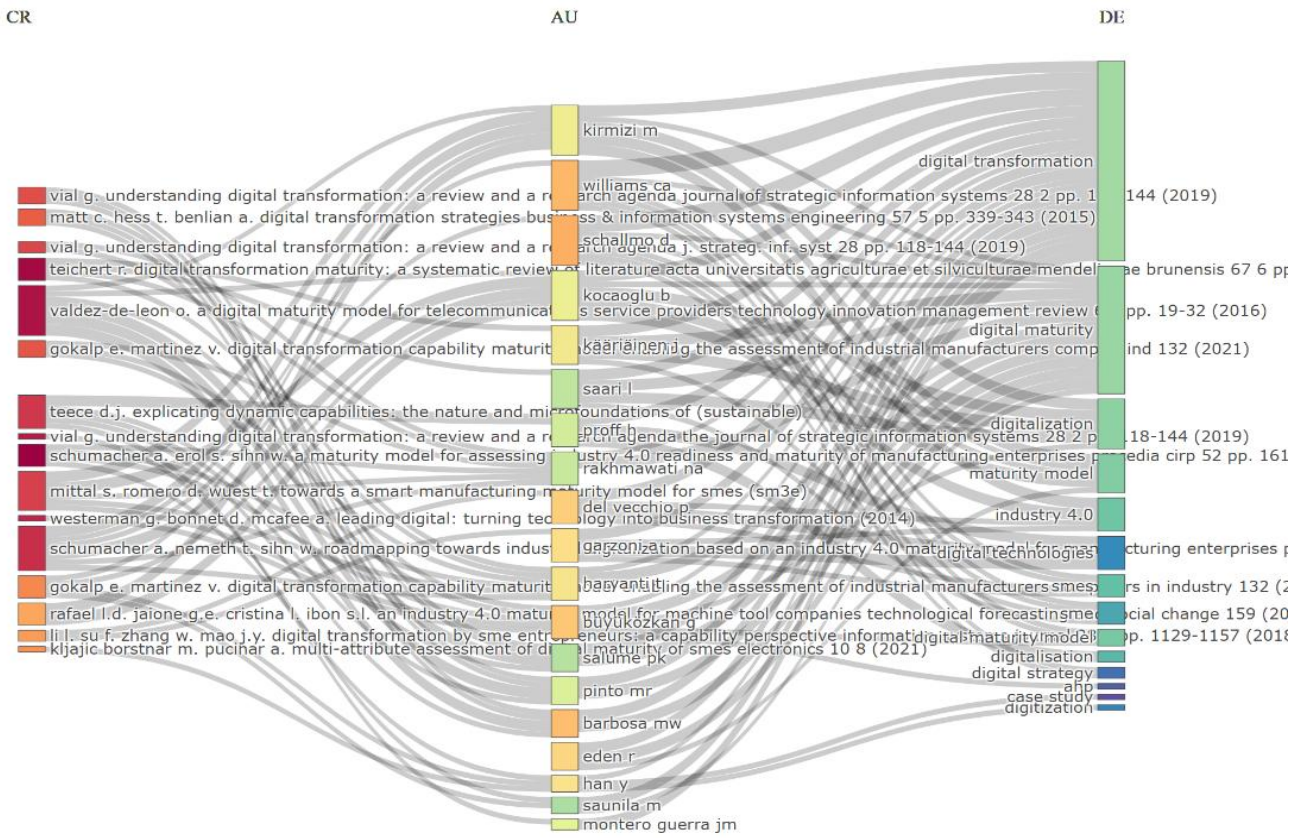

Figure 4. Frequently Cited References and Authors
Source: Data Processing using Rstudio (2024)

Figure 4 shows the results of citing references, authors, and keywords or research domains in the context of digital maturity and digital transformation. Several important references, including "Understanding Digital Transformation" by Vial G., "Digital Transformation Strategy" by Matt C., and "Digital Transformation Maturity" by Teichert T., are highly prevalent in the cited literature. This suggests that this research is a basic conceptual framework for related studies. Authors such as Kırmızı M., Williams CA, and Schumacher A. have made important contributions in this field, especially concerning developing maturity models and implementing Industry 4.0. The main focus of such literature is on keywords such as "Digital Transformation", "Maturity Models", and "Industry 4.0". This reflects the significant emphasis on measuring digital readiness and applying advanced technologies in various sectors, including small and medium-sized enterprises (SMEs).

Other themes, such as sustainability and capability assessment, show that digital transformation is evaluated based on its impact on organizational sustainability and capacity building. This visualization illustrates the evolution of research on digital maturity, showing the interconnections between theoretical frameworks, practical applications, and organizational readiness assessments in the context of digital transformation. The book is a valuable conceptual map explaining the relationships between key literature, leading authors, and current research trends. In addition, the book also guides further exploration, such as the development of sector-specific digital maturity models or a focus on managing sustainability in the context of digitalization.

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This study explores the growing importance of scientometric analyses in understanding the impact of digital transformation on research and development (R&D) across sectors. The study found a consistent increase in publications related to the maturity of digital transformation, signaling growing scholarly interest in this area among researchers and practitioners across multiple disciplines. This substantial increase in scholarly productivity underscores the need to understand how digital transformation is implemented and measured for maturity across organizations and sectors.

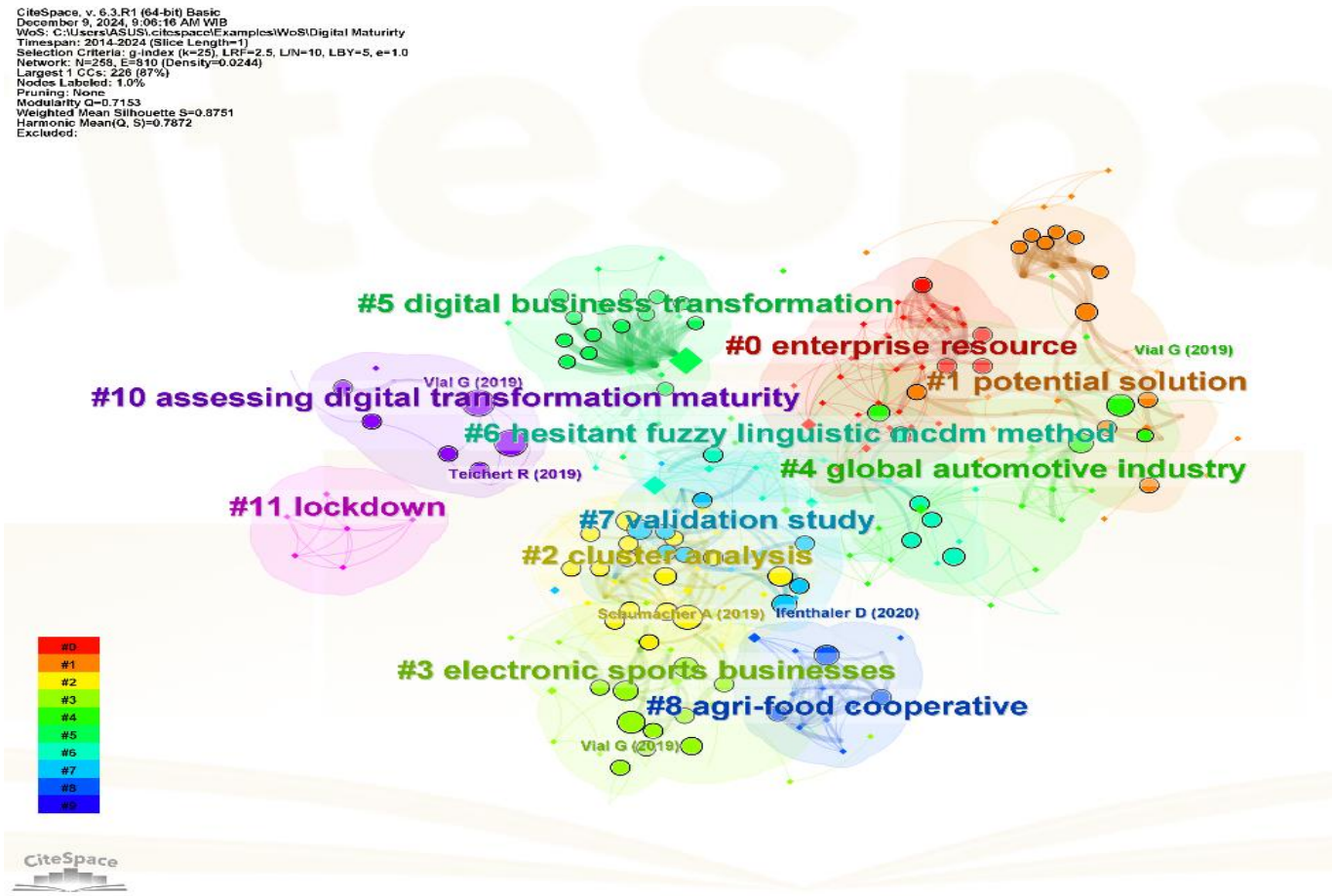

Figure 5. Set of Co-Cited References
Source: Data Processing using CiteSpace (2024)

Figure 5 presents a visual representation of the analysis results obtained through the use of CiteSpace, which describes the structure of the citation network based on scientific articles related to digital maturity. Each node represents a significant article or theme, and the node size reflects the citation frequency or importance of the article in the network. The colors of the nodes and lines indicate the temporal coverage of the study, with red indicating the earliest period and blue indicating the latest period. The analysis identified several clusters, the largest and most dominant of which was #0, "Enterprise Resources." This cluster indicates a major focus on managing company resources in the context of digitalization. It is crucial to consider the internal dynamics of the company, as well as external factors, including market conditions and regulatory frameworks (Song & Lin, 2022). Cluster #1, "Potential Solutions," focuses on developing solutions to digital transformation challenges. As a specific dimension of digital maturity, organizational culture has been represented in several models, showing culture's

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importance as a driver of digital transformation efforts (Teichert, 2019). Cluster #5, "Digital Business Transformation," focuses on implementing digital business transformation. Clusters such as #10, "Assessing Digital Transformation Maturity," demonstrate this study's importance of evaluating and measuring digital maturity. In addition, cluster #11 lockdown shows the impact of the pandemic on issues related to digital maturity, thus strengthening the temporal relevance of this study in the context of a global event. The relationships between clusters illustrate the interconnectedness of important themes, such as technology integration, assessment, and pragmatic solutions in digitalization implementation. This visualization illustrates that research on digital maturity is evolving with a comprehensive range of topics, including business aspects, assessment methodologies, and global contexts.

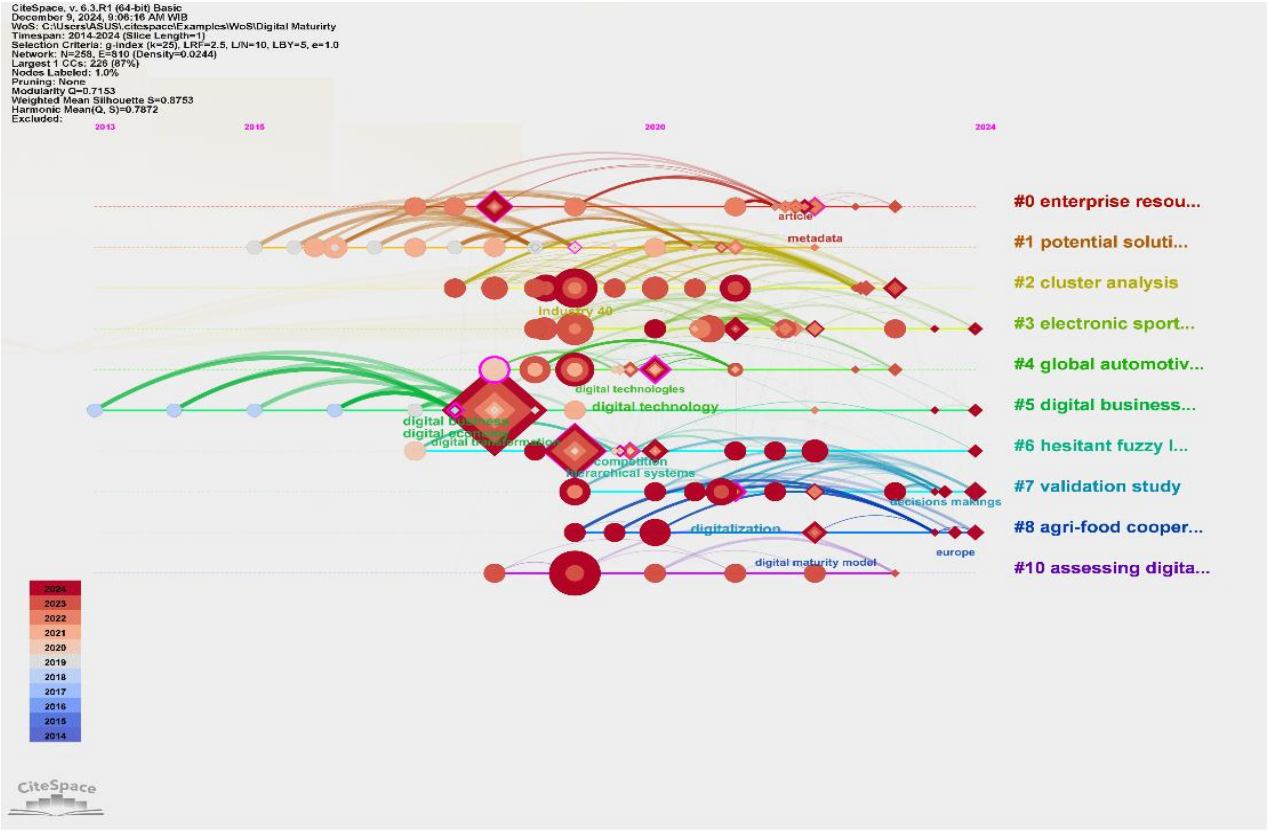

Figure 6. Timeline Display Based on Keywords
Source: Data Processing using CiteSpace (2024)

Figure 6, illustrated in the citation network visualization generated by CiteSpace, research on digital maturity and digital technologies is closely linked to the concept of digitalization in various sectors. Large clusters, such as "digital business" (#5) and "digital technology", suggest digital transformation has emerged as a strategic imperative for many companies, with the efficacy of these initiatives dependent on the capacity of IT departments to align themselves with evolving business demands (Isaev et al., 2018). a major emphasis on digital transformation in the areas of business and technology. In addition, the "digital maturity models" cluster (#10) illustrates the evolution of models used to assess the level of digital maturity in different organizations. The temporal dynamics are reflected in the use of colors, with red nodes and links indicating more recent research (2020-2024) and blue and green indicating earlier research (2013-2019). This highlights the shift in topics towards recent trends, such as integrating digital

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technologies in decision-making and applying digital models in global automotive (#4) and agricultural cooperation (#8). Large nodes with high connectivity in the network indicate works or concepts that have significantly influenced the literature related to digital maturity and digital technologies. In addition, the pattern of relationships between clusters provides insight into the nature of interdisciplinary collaboration, especially in terms of themes such as "validation studies" (#7) linked to other research areas. Overall, the network reflects the evolution and diversification of the literature on digital transformation and the role of technology in driving efficiency and innovation across different sectors.

In contrast to the tendency shown by previous research to be more fragmented and focussed on individual aspects of digital transformation, this research shows that digital transformation maturity models are increasingly evolving in an integrated manner with multiple interconnected dimensions. The findings from this research also indicate a trend transition towards practical applications within specific industry sectors. This phenomenon is evident in the analysis of Figure 6, which shows that recent research has increasingly concentrated on applying digital maturity in the automotive and agricultural industries. This shows a change from the previous research period, which mostly discussed the basic digital transformation concepts without specific applications in certain sectors.

Figure 7. TreeMap
Source: Data Processing using Rstudio (2024)

The map in **Figure 7** above illustrates the distribution of key themes related to digitalization and digital transformation in the literature. The largest theme is digital transformation (40 articles, 17%), indicating a dominant focus on how organizations adapt to technological change to support efficiency and innovation. This was followed by digital maturity (11 articles, 5%) and maturity models (11 articles, 5%), highlighting the attention to measuring and evaluating digital maturity in the context of such transformation. Themes such as digitalization (10 articles, 4%) and decision-making (9 articles, 4%) show that applying digital technologies is also closely linked to data-driven decision-making.

In addition, subthemes such as hierarchical systems, sustainability, and competition (3% each) focus on applying technology in managing organizational systems, achieving sustainability, and improving competitiveness. Specific themes such as Industry 4.0, blockchain,

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and the Internet of Things reflect the latest technological developments that support digitization. In contrast, themes such as small and medium enterprises (SMEs) underscore the importance of supporting small and medium enterprises in their digital transformation journey. This division of themes reflects the different complexity and approaches in leveraging digital technologies to drive organizational transformation, sustainability, and innovation.

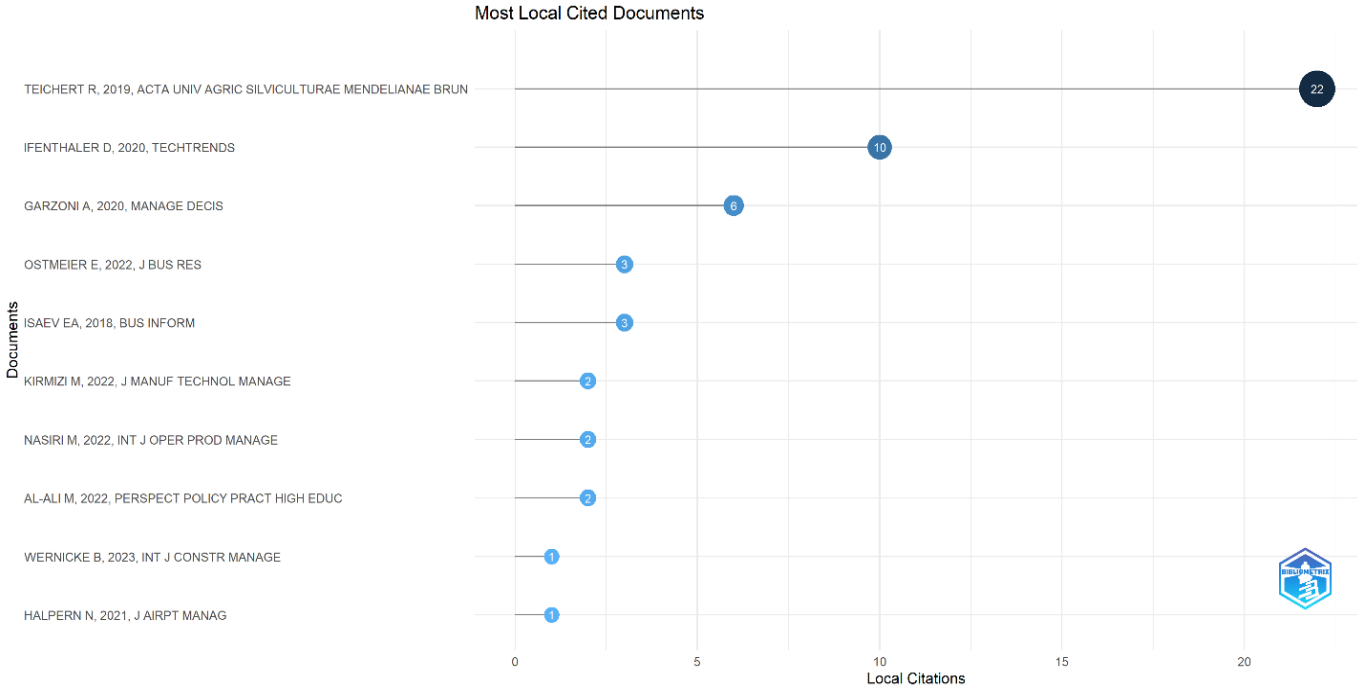

Figure 8. Most Local Cited Documents
Source: Data Processing using Rstudio (2024)

Figure 8 above illustrates the most frequently cited documents in analyzing local literature relating to digital transformation and technology. Teichert R (2019) is the most frequently cited document, with 22 local citations, thus underlining its relevance in the context of this study. The article is likely to significantly contribute to understanding the framework or implementation of digital transformation. The second document, Ifenthaler D (2020), had 10 local citations, indicating its influence in discussions about technological trends potentially related to education or digital innovation. In addition, Garzoni A (2020) and Ostmeier E (2022) have 6 and 3 citations, respectively, and most likely focus on decision management and business research relevant to digitalization.

Other articles with 2-3 citations, such as Isaev EA, 2018 and Nasiri M, 2022, can provide specialized perspectives on manufacturing technology development, technology-based decision-making, or sustainability in specific sectors. Documents with lower citation counts still offer valuable insights that contribute to a comprehensive understanding of core themes. The distribution of citations demonstrates the breadth of research interests, covering areas such as management, education, and the application of technology in various industries. This underscores the broad scope of digital transformation research and its important role in strategic decision-making.

This research has significant implications for both the development of theoretical concepts within academic circles and their practical applications in industrial settings. Future research endeavors could concentrate more intently on evaluating digital maturity, integrating technology in decision-making processes, and exploring specific sectors that have received

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comparatively less attention in the extant literature. From an industry perspective, the findings of this study suggest that companies need to adopt more systematic digital transformation strategies, optimize the use of data in management, and apply innovative technologies to improve efficiency and competitiveness. In the context of mounting complexity in business and technology environments, a more holistic and evidence-based approach to digital transformation is set to become imperative for the future sustainability of organizations.

5. Conclusion

This study provides a scientometric analysis of digital transformation maturity in research and development (R&D) over the past decade, highlighting key research trends, influential studies, and emerging thematic areas. By leveraging bibliometric data from Scopus (2015–2024) and employing advanced scientometric techniques, this study systematically maps the intellectual landscape of digital maturity and its implications for technological adaptation in various sectors.

The findings reveal that digital transformation maturity (DTM) has evolved as a critical concept in understanding how organizations integrate and optimize digital technologies. The analysis identifies dominant research themes, such as maturity models, decision-making frameworks, digital strategies, and sector-specific applications, underscoring the increasing significance of digital maturity in shaping institutional competitiveness and innovation. Moreover, the co-citation and keyword analysis indicate a shift towards practical digital transformation applications across industries, including healthcare, higher education, manufacturing, and public administration.

From a theoretical perspective, this study contributes to the literature by offering a structured overview of how DTM research has developed, highlighting gaps in conceptual frameworks, and identifying opportunities for integrating digital maturity models with emerging technologies such as artificial intelligence (AI), big data, and the Internet of Things (IoT). From a practical standpoint, the study provides valuable insights for researchers, policymakers, and industry leaders to optimize digital transformation strategies, enhance data-driven decision-making, and foster a more inclusive and sustainable digital ecosystem.

Future research on digital transformation maturity should explore several key directions to deepen understanding and improve practical applications across industries. One crucial area is the development of sector-specific digital maturity models, particularly in higher education, healthcare, and government institutions, where digitalization plays a pivotal role in enhancing service delivery and policy effectiveness. A comparative cross-country analysis would provide valuable insights into regional and institutional disparities in digital transformation readiness, considering variations in cultural, regulatory, and technological factors that shape digital adoption across different economies.

Moreover, future studies should integrate advanced analytical methods like network science, machine learning, and deep learning approaches to uncover more dynamic and predictive patterns in digital maturity evolution. These methods can enhance bibliometric analyses by providing more nuanced and data-driven insights into emerging trends and research trajectories. Another essential direction is longitudinal studies on digital maturity evolution, which would track how digital transformation frameworks develop over time and assess the long-term impact of digital strategies on organizational performance.

As digital transformation continues to reshape research and innovation landscapes, a holistic and data-driven approach is essential to ensure sustainable digital adoption, enhance institutional adaptability, and foster a more resilient and future-ready digital ecosystem.

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7. Declaration of Conflicting Interests

The author has declared no potential conflicts of interest regarding this article's research, authorship, and/or publication.

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About the Authors

1) **Riski** obtained his Bachelor's degree from Muhammadiyah University of Yogyakarta, Indonesia, in 2024. The author is a student of the Postgraduate Program at the Department of Government Affairs and Administration, Jusuf Kalla School of Government, Muhammadiyah University of Yogyakarta, Indonesia.
Email: riskytamiang18@gmail.com

2) **Achmad Nurmandi** obtained his Doctoral degree from the University of Indonesia in 2008. The author is a Professor at the Department of Political Islam - Political Science, Jusuf Kalla School of Government, Muhammadiyah University of Yogyakarta, Indonesia.
Email: nurmandi_achmad@umy.ac.id

3) **Muhammad Younus** obtained his Master's degree from Muhammadiyah University of Yogyakarta, Indonesia, in 2024. He works as a Business IT Analyst in the Product Research and Software Development Department at TPL Logistics Pvt Ltd, Karachi, Pakistan. In addition, he is pursuing a doctoral degree at Muhammadiyah University of Yogyakarta, Indonesia.
Email: mohammedyounusghazni@gmail.com

https://doi.org/10.33019/society.v13i1.800

4) **Herman Lawelai** obtained his Master's degree from Muhammadiyah University of Yogyakarta, Indonesia, in 2018. He is currently a lecturer in the Department of Government Studies at Universitas Muhammadiyah Buton, Indonesia, while also pursuing a doctoral degree at Muhammadiyah University of Yogyakarta, Indonesia.
Email: herman.lawelai@umbuton.ac.id

5) **Wahdania Suardi** obtained her Master's degree from Muhammadiyah University of Yogyakarta, Indonesia, in 2020. She is pursuing a doctoral degree at Muhammadiyah University of Yogyakarta, Indonesia.
Email: suardiwahdania@gmail.com

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