

Bibliometric Analysis of Workforce Planning in the Digital Age

Loso Judijanto¹, Helmita²

¹IPOSS Jakarta, Indonesia and losojudijantobumn@gmail.com

²Universitas Mitra Indonesia and mitahelmita@umitra.ac.id

ABSTRACT

The rapid advancement of digital technologies has transformed the way organizations plan, manage, and develop their workforce. Consequently, workforce planning has become increasingly important in helping organizations adapt to digital transformation, artificial intelligence, and evolving skill requirements. This study aims to examine the intellectual structure, research trends, and emerging themes of workforce planning in the digital age through a bibliometric analysis. Bibliographic data were retrieved from the Scopus database and analyzed using VOSviewer to identify publication patterns, influential publications, keyword relationships, author collaborations, institutional networks, and country-level collaborations. The results reveal that workforce planning research is primarily concentrated around themes such as personnel management, workforce development, digital transformation, artificial intelligence, information management, and healthcare workforce systems. The keyword co-occurrence analysis indicates that personnel, workforce, digital transformation, and workforce planning are the most prominent research topics, while overlay visualization highlights recent interest in digital-age workforce management, information systems, and data-driven decision-making. Citation analysis shows that digital health and technology-enabled workforce studies have significantly influenced the field. Furthermore, collaboration analysis demonstrates strong research partnerships among authors, institutions, and countries, with Australia emerging as a major contributor to international collaboration. The findings suggest that workforce planning research is shifting toward predictive, technology-enabled, and evidence-based approaches that emphasize workforce resilience, digital competencies, and organizational adaptability. This study contributes to the literature by providing a comprehensive overview of the evolution of workforce planning research and identifying promising directions for future investigations in the context of digital transformation.

Keywords: *Workforce Planning, Digital Transformation, Artificial Intelligence, Human Resource Management, VOSviewer*

1. INTRODUCTION

Digital technology's fast pace of development has brought about significant changes in the structure, functioning, and management of companies around the world. Innovations such as artificial intelligence, big data analytics, cloud computing, robotics, and the Internet of Things have drastically altered the nature of work and the skills that are needed in modern enterprises. Today, more and more organizations face pressure to adjust their operations to new disruptive technologies and continue being productive, innovative, and competitive at the same time [1], [2]. As a result, workforce planning has become an important organizational activity aimed at ensuring the presence of a competent workforce able to meet future demands. Workforce planning no longer consists merely of forecasting labor shortages or recruiting activities; rather, it concerns the alignment of human resource strategies with technological progress and digital transformation projects. As stated by [3], workforce planning is needed for forecasting organizational capability needs and training employees to cope with changes in economic and technological conditions.

The advent of digital transformation has resulted in changes even in the traditional methods of hiring people for work and managing them within an organization. Today, many organizations operate using virtual workspaces and digital tools that change the way people relate at workplaces. Organizations must find ways of managing recruitment, training, performance appraisal, and

retention among others in light of these new developments [4]. At the same time, the fact that most routine jobs are becoming automated raises concerns about job losses and skills obsolescence. It has been noted that strategic workforce planning is necessary to fill skill gaps, train employees, and sustain talent especially in highly digitalized organizations [4], [5]. Globally, it is recognized that there is need to create the future-ready workforce capable of dealing with the challenges brought about by Industry 4.0 and digital economy.

In conjunction with these changes, bibliometric analysis has been becoming increasingly helpful for assessing the progress of science in the specific discipline. Through bibliometric analysis, one can assess the trends of publications, important authors, cooperation networks, changes in topics, and the direction of research with the help of quantitative methods. This method is widely applied when measuring the intellectual structures of scientific research fields and the progress in science. Regarding workforce planning, the bibliometric analysis would be quite useful for gaining a comprehensive picture of how the problem area had changed due to the process of digitalization and advancements in technology. With the help of the scientific papers concerning workforce planning in the digital age, the main topics could be identified such as digital skills, talent management, use of artificial intelligence in human resource management, workforce analytics, telecommuting, and organizational agility. As [6] state, bibliometric techniques can efficiently synthesize extensive literature bodies and reveal patterns in scientific communication.

The rising significance of workforce planning in the digital age has led to the emergence of multidisciplinary studies that draw insights from management, information systems, organizational psychology, economics, and labor studies. Scholars have increasingly explored the integration of digital technologies within workforce planning policies while safeguarding the welfare of employees and ensuring organizational sustainability. Prior studies have addressed topics such as digital competence, workforce forecasting, automation effects, and digital leadership. Nevertheless, although there are many articles published on this topic, the literature still lacks cohesion as some of the articles stress technological innovations, whereas others concentrate on human resource development or organizational effectiveness. This situation makes it hard to gain a complete view of the scholarly growth and development of workforce planning in the digital age. Consequently, a bibliometric review is needed to map out the progression of research themes, recognize significant contributions, and point out gaps that need attention.

In addition, the outbreak of the COVID-19 pandemic contributed to faster digital transformation worldwide and made research on workforce planning even more relevant. Indeed, during the pandemic, organizations had to quickly switch to digital tools to ensure their business continuity through telecommuting, videoconferencing, and other digitalization techniques. In this way, numerous organizational weaknesses related to workforce readiness, digital infrastructure, and employee readiness were revealed, which encouraged researchers to study how workforce planning strategies could help companies be resilient and sustainable in the face of uncertainty [7], [8]. With regard to the current post-pandemic period, the importance of digital workforce management approaches is still emphasized by organizations that move to hybrid models of work. Hence, academic publications in the sphere of workforce planning in the digital age continue to increase year by year. At the same time, little information is currently available about the publishing patterns, main scholars, institutional collaboration, and research directions in this area. Consequently, conducting a bibliometric analysis of this topic will facilitate further insights into the knowledge base of workforce planning studies.

While the body of literature related to workforce planning in the digital era has been considerably broadened due to many publications released recently, there still is an apparent fragmentation of academic sources that cover different fields of study, topics, and methodologies employed in research papers. Due to the extensive number of works that address digital transformation, workforce analytics, talent management, automation, and other relevant issues, it becomes challenging to trace the general pattern and research trends in the domain under consideration. The previous studies were oriented towards particular organizational problems and issues of technology while ignoring the bigger picture of the scholarly area concerned. Thus, no detailed information has been provided about the changes in the scope of research questions, prominent contributors, collaboration networks, publication trends, and emerging themes in terms of workforce planning in the digital era. Moreover, the rapid pace of digitalization during and after the pandemic has initiated new debates on remote work, digital literacy, and organizational resilience; however, the issue has not been considered through bibliometric methodology. Other research objectives include examining collaboration networks of researchers and nations, studying the changes in research themes concerning digitalization and workforce management, and uncovering emerging issues that can be used for future academic research.

2. METHODS

The present study made use of the bibliometric research methodology for studying the trend in publications on workforce planning in the digital era. Bibliometrics involves an analytical method used to study scientific literature using metadata about the documents, citation patterns, and other data regarding research. Specifically, the objective was to study publication trends, prominent researchers, collaboration, research themes, and new areas associated with workforce planning and digital transformation. To conduct this study, sources of publications were collected from reliable databases, such as Scopus and Web of Science, since the two are known to contain extensive coverage of indexed peer-reviewed journals and quality scholarly publications. The keywords that were used to conduct the search included “workforce planning,” “digital workforce,” “digital transformation,” “human resource analytics,” and “future of work.” The inclusion criteria were limited to peer-reviewed journal articles, conference papers, and reviews dealing with the subject matter of workforce planning and digitalization.

Following the data collection process, the chosen sources were exported in compatible formats for conducting bibliometric analysis. The study employed several bibliometric techniques using software tools such as VOSviewer. Bibliometric analysis was performed using indicators such as the rate of publication growth per year, citation analysis, co-authorship network, co-citation analysis, keyword co-occurrence, and collaboration between countries. Citation analysis was done in order to determine the most cited papers, authors, and journals within the topic under investigation. The technique of co-authorship network analysis was used in order to explore collaborative networks between authors and institutions. Keyword co-occurrence analysis was applied in order to determine research themes and trends associated with workforce planning studies. Thematic maps created using software visualizations provided graphical illustrations of research themes and relationships between research variables.

To maintain the reliability and validity of the results, the data screening and analyses were carried out in a consistent manner all through the research period. Any duplicate documents and publications not relevant to the topic under investigation were first deleted before moving into the analysis phase. To aid in the interpretation of bibliometric patterns, the collected data set was sorted out according to publication year, source title, affiliation of authors, and focus of their work.

3. RESULT AND DISCUSSION

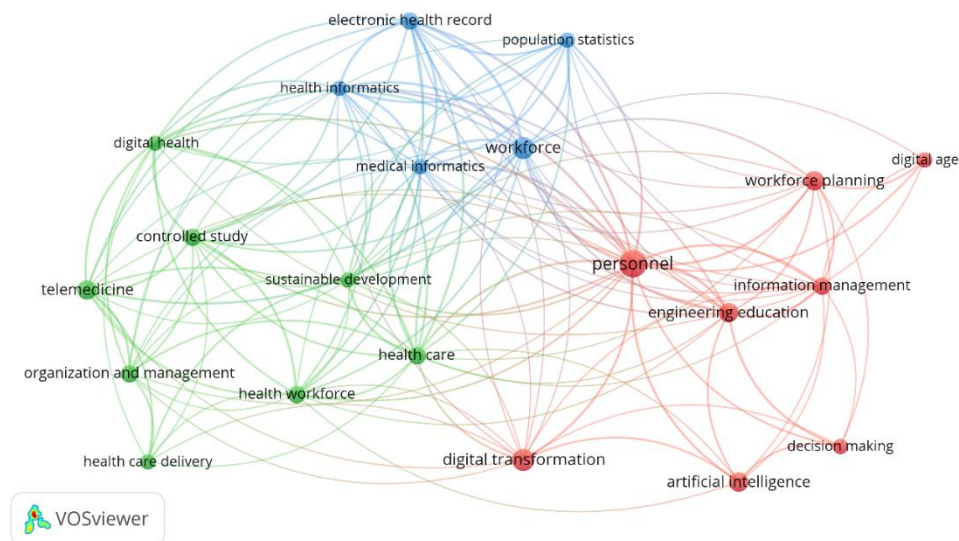


Figure 1. Network Visualization

Source: Data Analysis Result, 2026

From the analysis, it is evident that workforce planning in the digital era is characterized by three distinct thematic clusters within the keyword co-occurrence network. The first cluster, denoted by red circles, is associated with personnel, which happens to be among the key words that are highly interconnected. In other words, workforce planning relates to such terms as digital transformation, artificial intelligence, information management, decision-making, and engineering education. These associations indicate that current workforce planning has shifted towards the application of technology and data. In essence, the planning of the human resource management has gone beyond staffing needs and relies on technology to an increasing degree. The second cluster of keywords pertains to the perspective on workforce planning from the angle of healthcare and organizational management. These include health workforce, health care delivery, telemedicine, digital health, organization and management, and sustainable development. These keywords appear to be part of a coherent cluster, which signifies that healthcare has emerged as one of the most vibrant fields in terms of research related to workforce planning, especially considering the impact of digitization on the delivery of services in the field.

Blue Cluster: Workforce planning with respect to health informatics and data management. Some related keywords in this category include workforce, electronic health record, health informatics, medical informatics, and population statistics. These associations indicate that workforce planning is becoming data driven. Information in the form of electronic records, medical databases, and population data are used for predicting future workforce demands. This association between informatics and workforce planning shows the importance of evidence based approach in forecasting future needs. Network structure, on the other hand, shows that the categories of workforce, personnel, and health care represent bridging nodes among the three clusters. Bridging nodes are key concepts that allow the connection between research streams in technology, management, and health care. In addition, digital transformation placed close to the center of the network implies its role as a common topic among several research streams. Another noteworthy point in the analysis of network structure is the proximity of the categories of artificial intelligence and decision making.

3.1 Overlay Visualization

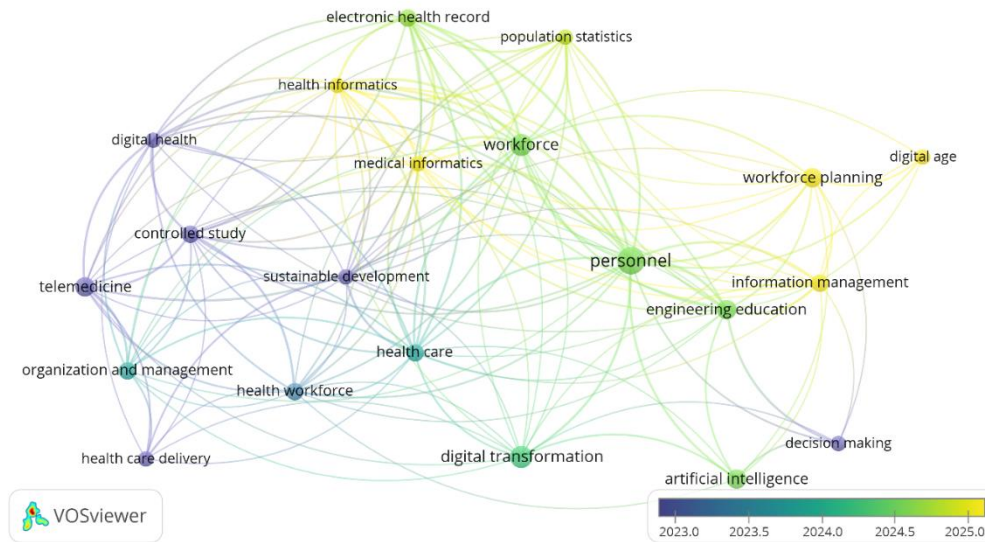


Figure 2. Overlay Visualization

Source: Data Analysis Result, 2026

The overlay graph depicts the evolution of workforce planning research from 2023 to 2025. The earlier works that are shown in blue and purple colors focused mainly on issues associated with health, including telemedicine, digital health, health care delivery, controlled study, and organization and management. Such a tendency shows that the first debates concerning the workforce planning in the digital era were significantly shaped by issues related to healthcare, which implies that one of the major issues that the workforce in healthcare had to deal with was how to cope with workforce capacity in the process of health care delivery during the period of rapid digital changes. With further development into 2024, studies began to focus on larger organizational and technological factors, which are evidenced by the keywords in green color, including "workforce," "personnel," "digital transformation," "artificial intelligence," "engineering education," and "health care." These keywords play crucial roles in the network since they represent the bridging elements in healthcare, management, and technological research domains. The emerging importance of digital transformation and artificial intelligence suggests that workforce planning is becoming a strategic endeavor for organizations to predict future needs for skills and technology-based decision making.

The latest trends in research, depicted through the yellow colored keywords between 2025, consist of workforce planning, digital age, information management, health informatics, medical informatics, and population statistics. Their presence in the list of emerging concepts implies that the development path of the domain would be towards complex and evidence-based workforce planning. More specifically, scholars seem to pay attention to the application of information technologies and workforce intelligence for developing future-oriented strategies. The emergence of the concept of digital age highlights an increased interest in studying how to adapt the organization's approach to workforce planning to modern technological advances.

3.2 Citation Analysis

Table 1. The Most Impactful Literatures

Citations	Authors and year	Title
138	[9]	The role of digital health in making progress toward Sustainable Development Goal (SDG) 3 in conflict-affected populations

Citations	Authors and year	Title
134	[10]	Consumer preferences for Mobility-as-a-Service (MaaS) in Australia
20	[11]	Universal Health Coverage and the Pacific Islands: An Overview of Senior Leaders' Discussions, Challenges, Priorities and Solutions, 2015–2020
14	[12]	The evolution of human resources in the age of technology
14	[13]	Nurse managers' perceptions of mentoring in the multigenerational workplace: a qualitative descriptive study
11	[14]	Dental age estimation of Omani children using Demirjian's method
9	[15]	Fires, forests and futures: The ANU westoby lecture
8	[16]	Acceptability of a mHealth strategy for hypertension management in a low-income and middle-income country setting: A formative qualitative study among patients and healthcare providers
5	[17]	Digital human modeling of obese & aging workers in automotive manufacturing
3	[18]	Exploring diverse use cases of digital twins projecting digital transformation: Unlocking potential, addressing challenges and viable solutions

Source: Scopus, 2026

In Table 1, it can be seen that the most relevant literature is concentrated around the following topics: digital health; healthcare workforce; and technology-enabled service transformation. The most cited paper by [9], with 138 citations, demonstrates a link between digital health and the concepts of sustainable development and health equity among vulnerable populations. There are other highly cited papers related to healthcare systems, such as universal health coverage; management of hypertension via mHealth; nurse management; and health-specific digital transformation. Nevertheless, the presence of papers on Mobility-as-a-Service; dental age determination; forest future scenarios; and digital twins implies thematic variation.

3.3 Density Visualization

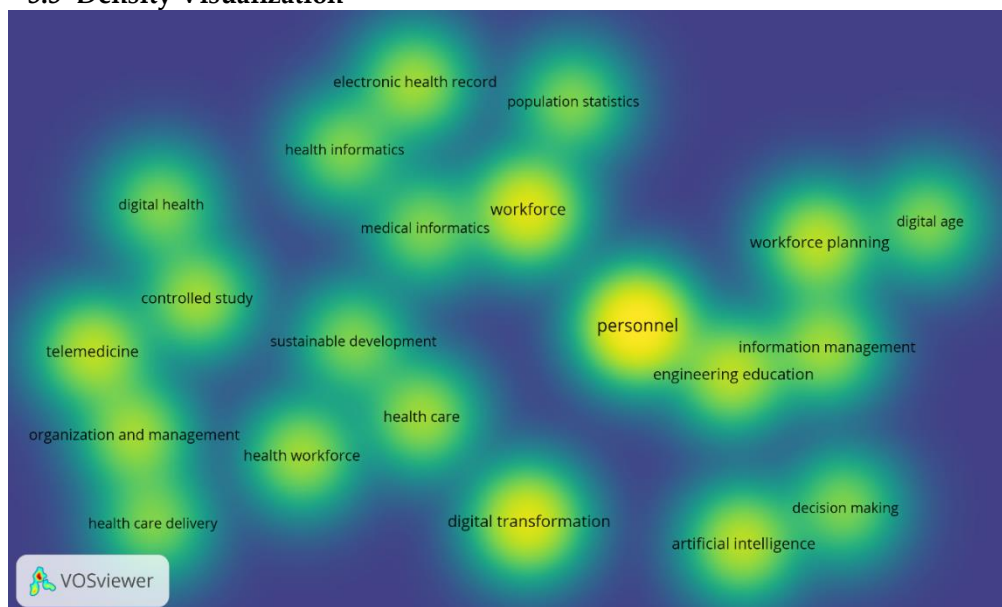


Figure 3. Density Visualization

Source: Data Analysis Result, 2026

The density visualization highlights the most frequently occurring and strongly connected topics within the workforce planning literature. Areas displayed in bright yellow indicate the highest research concentration, with personnel emerging as the dominant keyword in the network. Other highly dense themes include workforce, digital transformation, artificial intelligence, workforce planning, and information management. The prominence of these terms suggests that current research is heavily focused on managing human resources within digitally transformed environments, emphasizing the integration of advanced technologies, data-driven decision-making, and strategic workforce development. These hotspots represent the intellectual core of workforce planning research in the digital age. On the other hand, the presence of keywords in the green and blue zones implies a relatively lower degree of research concentration, thus implying either the specialization or emergence of particular topics for study. Some of the concepts include digital health, telemedicine, electronic health records, population statistics, health workforce, and sustainable development. These keywords pertain to vital, but comparatively under-represented, fields of research that can be connected mainly with the management of healthcare workers as well as digital health care. Therefore, the implication in the visualization is that although workforce planning research emerged from various sources of knowledge like those related to organizational management and health care, it is gradually focusing more on themes like digitalization, artificial intelligence, workforce analytics, and information management.

3.4 Co-Authorship Analysis

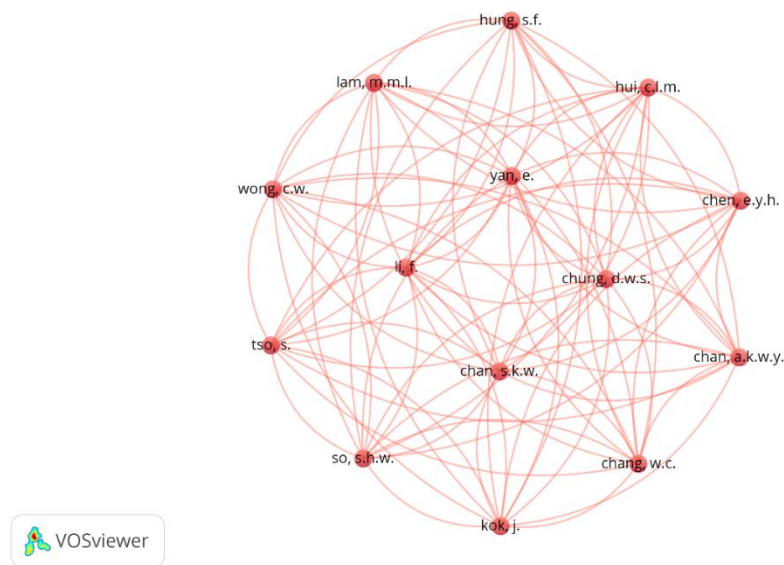


Figure 4. Author Visualization

Source: Data Analysis Result, 2026

It can be seen from the graph of collaboration of authors that there is a high degree of interconnectivity in the research area, since all the authors are connected by a network of numerous connections within one cluster. Authors like Li, F., Yan, E., Hung, S.F., Chung, D.W.S., and Chan, S.K.W. can be considered fairly central and thus have significant contributions in the development of collaborative practices within this sphere of study. There are no other clusters apart from the one mentioned above, which implies that the research field on the topic of workforce planning in the digital era is marked with well-developed collaboration between its members. Collaboration of such a scale suggests the interdisciplinary nature of research on workforce planning, since the study in question often requires specialists in human resource management, digitalization, information systems, health care management, and organizational studies.

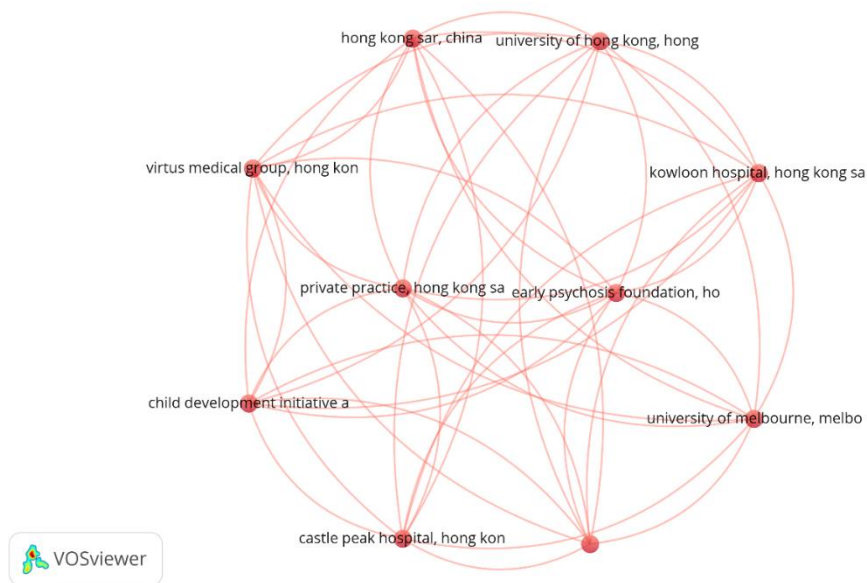


Figure 5. Institution Visualization
 Source: Data Analysis Result, 2026

The institutional collaboration network reveals a relatively concentrated research structure dominated by organizations located in Hong Kong, with additional collaboration involving the University of Melbourne in Australia. Institutions such as the University of Hong Kong, Hong Kong SAR, Kowloon Hospital, Castle Peak Hospital, Private Practice Hong Kong, and the Early Psychosis Foundation occupy central positions and are connected through numerous collaborative links. The dense network and the presence of only a single cluster indicate a high degree of cooperation among institutions, suggesting that workforce planning research in the digital age is being developed through closely integrated partnerships rather than isolated institutional efforts. The strong representation of hospitals, healthcare organizations, and universities further reflects the significant contribution of the healthcare sector to the advancement of workforce planning research. Moreover, the connection with the University of Melbourne demonstrates the presence of international collaboration, which facilitates the exchange of knowledge, expertise, and research perspectives across national boundaries.

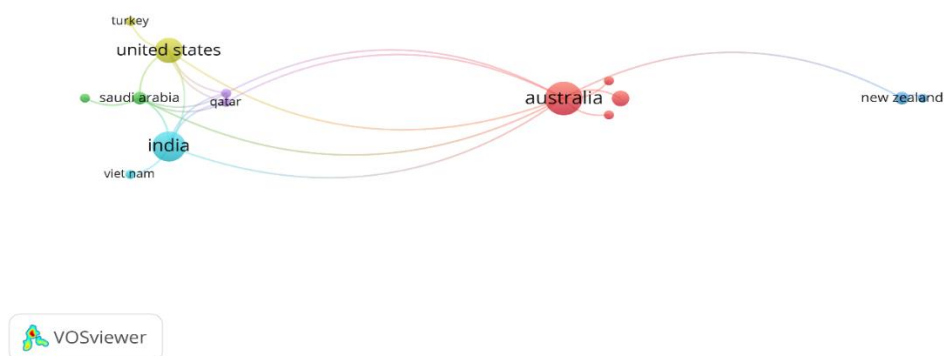


Figure 6. Country Visualization
 Source: Data Analysis Result, 2026

According to the country collaboration network map, Australia is the most powerful and globally connected country when it comes to conducting research on workforce planning in the digital era. This is supported by the fact that it has a bigger node size than any other nation alongside being connected to various countries such as India, USA, and New Zealand. Being located at the center of this network means that Australia plays a very crucial role in facilitating knowledge production and international collaborations, thereby promoting workforce planning research activities. The network also shows additional collaboration clusters between smaller numbers of countries, including India, Saudi Arabia, Qatar, Vietnam, and Turkey. It is observed that India acts as a secondary collaboration node because it has research collaboration with both developed and developing nations. On the other hand, the US holds a prominent position even with a small collaboration network. This indicates that it still holds its importance in workforce and management literature. As can be seen, many interconnected countries are involved, which indicates the increasing global nature of workforce planning research where researchers from various countries work together on common problems.

CONCLUSION

Through this bibliometric study, it is evident that the field of workforce planning has transformed to become an interdisciplinary research area that encompasses workforce management, digital transformation, artificial intelligence, information management, and healthcare. From the keyword analysis, the top influential keywords were personnel, workforce, workforce planning, digital transformation, and artificial intelligence, hence pointing out the increased focus on technology-based and data-driven approaches to workforce management. Through overlay visualization, it became apparent that the current research trend focuses more on the issues related to workforce planning, information management, and digital era compared to topics like telemedicine and digital health in the field of healthcare. Citation analysis results indicate that the most influential articles relate to digital health and technology adoption. In terms of authorship, collaboration, and institutional cooperation, there was notable collaboration among authors, institutions, and nations. Healthcare institutions and universities are major players in the production of knowledge in the field. It is also important to note that Australia is leading in international collaboration research on workforce planning and digital transformation.

REFERENCES

- [1] A. V Miranda *et al.*, "Adaptation of health systems to climate change-related infectious disease outbreaks in the ASEAN: Protocol for a scoping review of national and regional policies," *PLoS One*, vol. 18, no. 6 June, 2023, doi: 10.1371/journal.pone.0286869.
- [2] D. Febriyenti and Jamilus, "Human Resource Management in Islamic Educational Institutions at Integrated Islamic Junior High Schools," *J. Islam. Educ. Students*, vol. 3, no. 1, pp. 62–71, Jul. 2023, doi: 10.31958/JIES.V3I1.9492.
- [3] S. L. Myhre, K. B. Frønsdal, H. M. R. Ames, and E. Papadopoulou, "A scoping review of climate resilient health system strategies in low-resource settings," *Public Health*, vol. 249, 2025, doi: 10.1016/j.puhe.2025.106026.
- [4] B. Rushton *et al.*, "Future-proofing nature-based tourism in Canada: a horizon scan of emerging challenges," *Curr. Issues Tour.*, vol. 29, no. 4, pp. 654–680, 2026, doi: 10.1080/13683500.2024.2431526.
- [5] A. M. Mosadeghrad, P. Isfahani, L. Eslambolchi, M. Zahmatkesh, and M. Afshari, "Strategies to strengthen a climate-resilient health system: a scoping review," *Global. Health*, vol. 19, no. 1, 2023, doi: 10.1186/s12992-023-00965-2.
- [6] N. Donthu, S. Kumar, D. Mukherjee, N. Pandey, and W. M. Lim, "How to conduct a bibliometric analysis: An overview and guidelines," *J. Bus. Res.*, vol. 133, pp. 285–296, 2021.
- [7] S. Opara and P. Stanton, "Doing the right thing: HRM in the performing arts," *Asia Pacific J. Hum. Resour.*, vol. 61, no. 2, pp. 423–441, 2023.
- [8] L. B. Liboni, L. O. Cezarino, C. J. C. Jabbour, B. G. Oliveira, and N. O. Stefanelli, "Smart industry and the pathways to HRM 4.0: implications for SCM," *Supply Chain Manag. An Int. J.*, vol. 24, no. 1, pp. 124–146, 2019.
- [9] Y. M. Asi and C. Williams, "The role of digital health in making progress toward Sustainable Development Goal (SDG) 3 in conflict-affected populations," *Int. J. Med. Inform.*, vol. 114, pp. 114–120, 2018.
- [10] A. Vij, S. Ryan, S. Sampson, and S. Harris, "Consumer preferences for Mobility-as-a-Service (MaaS) in Australia," *Transp. Res. Part C Emerg. Technol.*, vol. 117, p. 102699, 2020.
- [11] A. T. Craig, K. Beek, K. Gilbert, T. S. Soakai, S.-T. Liaw, and J. J. Hall, "Universal health coverage and the Pacific islands: an overview of senior leaders' discussions, challenges, priorities and solutions, 2015–2020," *Int. J. Environ.*

- Res. Public Health*, vol. 19, no. 7, p. 4108, 2022.
- [12] S. Subrahmanyam, "The evolution of human resources in the age of technology," in *Technological enhancements for improving employee performance, safety, and well-being*, IGI Global Scientific Publishing, 2025, pp. 229–256.
- [13] T. Coventry and A.-M. Hays, "Nurse managers' perceptions of mentoring in the multigenerational workplace: a qualitative descriptive study," *Aust. J. Adv. Nurs.*, vol. 38, no. 2, pp. 34–43, 2021.
- [14] S. Al Balushi, W. M. Thomson, and L. Al-Harhi, "Dental age estimation of Omani children using Demirjian's method," *Saudi Dent. J.*, vol. 30, no. 3, pp. 208–213, 2018.
- [15] I. Ferguson, "Fires, forests and futures: the ANU Westoby lecture," *Aust. For.*, vol. 72, no. 4, pp. 195–205, 2009.
- [16] B. Bhandari, A. E. Schutte, R. Jayasuriya, A. Vaidya, M. Subedi, and P. Narasimhan, "Acceptability of a mHealth strategy for hypertension management in a low-income and middle-income country setting: a formative qualitative study among patients and healthcare providers," *BMJ Open*, vol. 11, no. 11, p. e052986, 2021.
- [17] S. Ngo, C. M. Sommerich, and A. F. Luscher, "Digital human Modeling of Obese & Aging Workers in automotive manufacturing," in *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, SAGE Publications Sage CA: Los Angeles, CA, 2016, pp. 1041–1045.
- [18] B. Singh and A. Nayyar, "Exploring diverse use cases of digital twins projecting digital transformation: Unlocking potential, addressing challenges and viable solutions," in *Digital Twins for Smart Cities and Villages*, Elsevier, 2025, pp. 631–655.