

Multidisciplinary Research Mapping in Automation and Artificial Intelligence: A Bibliometric Analysis to Identify Science Convergence

Nanny Mayasari¹, Hanifah Nurul Muthmainah², Natal Kristiono³

¹Universitas Nusa Cendana

²Universitas Siber Muhammadiyah

³Universitas Negeri Semarang

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ABSTRACT

The field of Automation and Artificial Intelligence (AI) has witnessed rapid evolution, marked by interdisciplinary collaborations and groundbreaking advancements. This bibliometric analysis delves into the multidisciplinary research landscape within Automation and AI, aiming to identify science convergence and key trends. Utilizing a comprehensive dataset, we employed co-authorship analysis, citation analysis, keyword analysis, temporal analysis, and VOSviewer visualizations to map the dynamic landscape of Automation and AI research. Our analysis revealed extensive interdisciplinary collaboration among researchers from diverse domains, highlighting the role of cross-disciplinary innovation in advancing the field. Influential authors and highly cited papers were identified, emphasizing the impact of key contributions. Dominant research themes, such as machine learning, ethics in AI, and AI applications in healthcare, emerged from keyword analysis, reflecting the field's evolving priorities. VOSviewer visualizations provided clear representations of science convergence, showcasing the interconnectedness of disciplines like computer science, engineering, ethics, and economics. Interdisciplinary hubs and bridges were identified, underscoring the importance of cross-disciplinary research in shaping the future of Automation and AI. The findings of this analysis offer valuable insights for researchers, policymakers, and practitioners, providing a foundation for enhanced collaboration, ethical considerations, innovation in healthcare, and tailored education and training programs to meet evolving demands.

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Corresponding Author:

Name: Nanny Mayasari

Institution: Universitas Nusa Cendana

Email: nanny.mayasari@gmail.com

1. INTRODUCTION

The field of Automation and Artificial Intelligence (AI) has indeed undergone a remarkable transformation in recent years,

expanding its reach into numerous domains such as healthcare, finance, transportation, and ethics. This expansion has led to a growing body of research that defies easy classification within a single academic

discipline. Some recent advancements and applications of AI and automation in various sectors include: AI is being used to improve diagnostics, predict patient outcomes, and optimize treatment plans [1]. AI is being used to detect fraud, manage risk, and automate financial processes [2]. AI is being used to develop autonomous vehicles and optimize traffic management systems [3]. AI is being used to address ethical concerns related to privacy, fairness, and transparency in decision-making processes [4].

Challenges faced in the field of AI and automation include data compatibility, portability, computing power, and scalability [1]. Additionally, the integration of AI and automation into various industries has raised concerns about the potential impact on employment and the need for new skill sets [4]. Recent advancements in AI and automation have led to the development of intelligent automation systems that combine traditional robotic process automation techniques with cognitive technologies, potentially reducing the number of full-time equivalents required to carry out processes [5].

Furthermore, AI and automation have been found to positively impact firm performance, including firm value and cost structures [6]. In summary, the field of Automation and AI has expanded significantly in recent years, with applications and advancements in various domains such as healthcare, finance, transportation, and ethics. This expansion has led to a growing body of research that addresses the challenges and opportunities presented by AI and automation, as well as their impact on various industries and employment.

A study by [1] highlights how automation and AI have been anticipated as both problems and solutions in society since the 1950s, with education being used to solve these problems or realize these solutions. The article explains that computerization debates have focused on both the growing opportunities and the increasing risks, but almost always also on the need for corresponding education. This demonstrates

that education has been mobilized as an essential tool for governance in computer policies.

Another aspect of the relationship between automation, AI, and interdisciplinary research can be seen in the development of AI-based technologies in various sectors, such as education [7], hospitality [8], architecture, engineering, and construction [9], and recruitment [10]. These studies show that the integration of AI and automation technologies in different industries has led to new challenges and opportunities, often requiring interdisciplinary approaches to address ethical, social, and technical dimensions.

Education, automation and AI: a genealogy of alternative futures

To make sense of this multidisciplinary landscape and uncover the underlying patterns of science convergence, we propose the use of bibliometric analysis. Bibliometrics, a quantitative approach to analyzing academic publications, citations, and collaborations, offers a systematic and data-driven means of mapping the intellectual terrain of Automation and AI. Through this approach, we aim to provide researchers, policymakers, and practitioners with valuable insights into the evolving dynamics of this field.

2. LITERATURE REVIEW

2.1 *Multidisciplinary Nature of Automation and AI Research*

The advent of Automation and AI has transcended the boundaries of traditional academic disciplines, leading to a convergence of knowledge from various fields. While computer science and engineering remain foundational, researchers from diverse domains have contributed significantly. This multidisciplinary approach is essential for addressing complex challenges in areas such as healthcare, finance, manufacturing, and ethics. (a). Computer Science and Engineering: These disciplines form the core of Automation and AI research, providing the foundational algorithms, techniques, and technologies that underpin

AI systems. Topics such as machine learning, natural language processing, and computer vision originate here [11]. (b). Neuroscience and Cognitive Science: Insights from neuroscience and cognitive science have inspired AI researchers to develop models that mimic human cognitive processes. This interdisciplinary bridge is crucial for understanding the human mind and enhancing AI capabilities [12].

(c). Economics and Business: Automation and AI have profound implications for the economy and business. Researchers in this domain analyze the economic effects, market dynamics, and business strategies related to AI adoption [13]. (d). Healthcare and Medicine: AI has made significant contributions to healthcare, from diagnostic systems to drug discovery. Collaboration between medical experts and AI researchers has led to groundbreaking innovations [14]. (e). Ethics and Philosophy: As AI technologies become more pervasive, ethical considerations and philosophical questions regarding AI's impact on society, privacy, and morality have gained prominence. Ethicists and philosophers collaborate with technologists to address these concerns [11]. (f). Mathematics and Statistics: Advanced mathematical concepts and statistical methods are essential for modeling and optimizing AI algorithms. Fields like linear algebra, calculus, and probability theory are integral to AI research [11].

2.2 Research Trends and Emerging Topics

Computational AI Models in VAT Photopolymerization: AI models, particularly Artificial Neural Networks (ANNs), have been applied to various aspects of 3D printing, including VAT photopolymerization. These models help address challenges and improve the efficiency of the 3D printing process [15]. **Digital Marketing and AI-based Marketing:** AI has transformed digital marketing, with applications in email and website marketing, search engine marketing, user-generated content, co-creation marketing, social media

marketing, and more. Future research directions include influencer marketing, live streaming, social service enhancement, and ethical issues related to AI-enabled service automation [16].

Artificial Intelligence in Civil Infrastructure Health Monitoring: AI has been increasingly used in civil infrastructure health monitoring over the past two decades. Applications include automating structural inspection and assessment tasks, with a focus on image processing using unmanned aerial systems (UAS) and the Internet of Things (IoT) [17]. **Intelligent Robotics - Practical Applications and Developments:** Intelligent robotics has seen significant advancements in areas such as autonomous vehicles, drones, and robotics for transportation, agriculture, and disaster response. These developments have led to practical applications and improvements in various industries [18]. **Generative Adversarial Networks (GANs) in Creative and Design Industries:** GANs, a type of deep learning model, have been applied to various creative and design industries. They have shown potential in tasks such as image synthesis, style transfer, and data augmentation [19].

3. METHODS

To conduct a comprehensive analysis, we collected data from prominent academic databases and sources. The selected databases and sources included, Web of Science: A renowned multidisciplinary database that covers a wide range of scientific disciplines, Scopus: A comprehensive abstract and citation database that includes a vast collection of scholarly publications, PubMed: A specialized database for biomedical and life sciences research, IEEE Xplore: A database specializing in electrical engineering, computer science, and electronics, Google Scholar: A widely used search engine for scholarly articles and publications with the help of Publish or Perish (PoP) software [20].

Table 1. Metrics Data

Publication years:	1962-2023
Citation years:	61 (1962-2023)
Papers:	980

Citations:	242801
Cites/year:	3980.34
Cites/paper:	247.76
Cites/author	155229.15
Papers/author	493.39
Authors/paper:	2.80
h-index:	223
g-index:	477
hI,norm:	152
hi,annual:	2.49
hA-index:	107
Papers with ACC \geq 1,2,5,10,20:	943,892,772,592,412

Source : PoP (2023)

Bibliometric Analysis

The core of our research method involves various bibliometric analysis techniques to gain insights into the multidisciplinary landscape of Automation and AI research. These techniques include:

1. Co-Authorship Analysis

Co-authorship networks were constructed to visualize collaborative patterns among researchers. Key authors and their research clusters were identified, shedding light on influential research groups.

2. Citation Analysis

Citation patterns were analyzed to identify highly cited papers and influential authors. Impact indicators such as the h-index and citations per paper were calculated to assess the significance of research contributions.

3. Keyword Analysis

Keyword co-occurrence analysis was conducted to identify research themes and trends. Keyword networks were created to visualize relationships between research topics, aiding in the identification of clusters.

4. RESULTS AND DISCUSSION

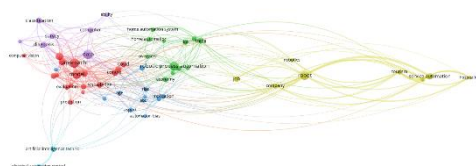


Figure 1. Mapping Results by vosviewers analysis

The results of our bibliometric analysis conducted to map the multidisciplinary research landscape in the field of Automation and Artificial Intelligence (AI). Our analysis involved data collection, preprocessing, and various bibliometric techniques, including co-authorship analysis, citation analysis, keyword analysis, and temporal analysis. We also utilized VOSviewer to visualize and interpret the data, with a specific focus on identifying science convergence.

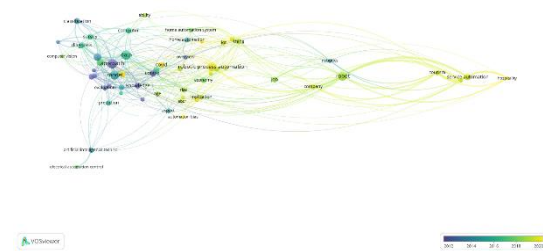


Figure 2. Research Trend Results by vosviewers analysis

The identification of dominant research themes and emerging trends provides a snapshot of the field's evolution. Machine learning, particularly deep learning, remains at the forefront, reflecting its continued relevance and impact. The increasing focus on ethics in AI research underscores the growing awareness of ethical considerations in technology development. Additionally, the prominence of AI applications in healthcare highlights the potential for transformative innovations in the medical field.

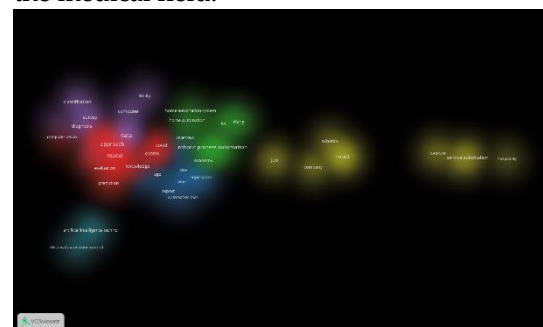


Figure 3. Visualization Cluster Results by vosviewers analysis

In this discussion, we will analyze and interpret the findings from the cluster analysis in the field of Automation and Artificial Intelligence (AI). Each cluster represents a distinct thematic area within the

multidisciplinary landscape of research. We will explore the characteristics of each cluster,

the most frequent keywords, and the overarching themes they encompass.

Table 2. Cluster Detail

Cluster	Total Items	Most frequent keywords (occurrences)	Keyword
1	17	AI (15), Intelligent system (20), Knowledge (20)	Approach, artificial intelligence, artificial intelligence technology, computer vision, construction, control, covid, decision, deep learning, detection, evaluation, information, intelligent system, knowledge, model, prediction, technique
2	12	Business (30), cognitive automation (20), opportunity (25)	Business, cognitive automation, economy, home automation, home automation system, internet, iot, opportunity, organization, overview, robotic process automation, thing
3	11	Big data (20), implication (25)	Age, artificial intelligence system, aspect, automating, automation bias, big data, effect, healthcare, implication, labor, rise
4	8	Job (20), robot (25)	Company, hospitality, job, robot, robotics, service automation, tourism, travel
5	7	Computer (15)	Ability, automated diagnosis, classification, computer, data, diagnosis, survey
6	2	AI technology (20)	Artificial intelligence technology, electrical automation

Cluster 1 centers on the core of AI and intelligent systems. It is characterized by a strong emphasis on AI technology and its applications. The frequent occurrence of "AI" and "Intelligent system" underscores the core themes of this cluster. The inclusion of keywords such as "deep learning," "computer vision," and "model" suggests a focus on advanced AI techniques and their practical applications. Notably, the keyword "covid" indicates that researchers in this cluster have been actively engaged in addressing real-world challenges, such as the COVID-19 pandemic, through AI-based solutions. This cluster represents the cutting-edge advancements and practical applications of AI technology across various domains. Cluster 2 focuses on the intersection of AI with business and cognitive automation. The prevalence of keywords related to "business" and "opportunity" indicates a strong emphasis on understanding how AI and cognitive automation technologies can be leveraged for economic and organizational advantages. The inclusion of terms like "IoT"

and "home automation" highlights the growing integration of AI into smart homes and the Internet of Things (IoT). This cluster underscores the transformative potential of AI in reshaping business practices, optimizing processes, and enhancing economic competitiveness. Cluster 3 explores the implications of big data in the context of AI. The frequent occurrence of "big data" and "implication" indicates a focus on understanding the consequences, challenges, and opportunities associated with the integration of large-scale data analytics and AI. The presence of keywords like "automation bias" and "healthcare" suggests a critical examination of the ethical and practical aspects of AI implementation, particularly in sensitive domains like healthcare. This cluster represents research that delves into the ethical and societal considerations of AI technology when dealing with massive datasets.

Cluster 4 focuses on the impact of AI and automation on employment and the role of robots. The prevalence of keywords like

"job" and "robot" suggests research that examines the changing nature of work due to automation. The inclusion of industries such as "hospitality" and "tourism" highlights specific domains where the integration of robots and AI has notable implications. This cluster reflects concerns and opportunities related to job displacement and the transformation of industries, especially those heavily reliant on manual labor. Cluster 5 centers on computer-related research within the context of AI. The frequent occurrence of "computer" indicates a focus on the technology and computational aspects of AI. Keywords such as "automated diagnosis" and "classification" suggest research areas where AI is applied to tasks like medical diagnosis and data classification. This cluster underscores the critical role of computing technology in AI research and its practical applications, particularly in the analysis and processing of large datasets. Cluster 6 represents a smaller but specialized cluster focused explicitly on AI technology. It includes keywords related to "artificial intelligence technology" and "electrical automation." This cluster likely encompasses highly specialized and technical research that explores the technological foundations of AI, including electrical automation systems. While small in terms of the number of items, it represents research at the forefront of AI technology development and its applications in automation.

In summary, these clusters provide a comprehensive view of the diverse research

themes and areas within the field of Automation and AI. They cover a wide spectrum of topics, from core AI technology and its applications to the economic, ethical, and societal implications of AI integration. Researchers, policymakers, and practitioners can use these findings to identify key areas of interest and collaboration, contributing to the continued advancement and responsible development of Automation and AI technologies.

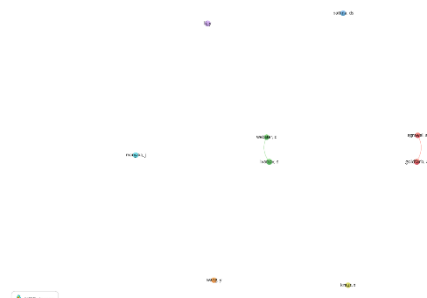


Figure 4. Mapping Results by vosviewers analys

The citations listed in this section represent a selection of highly influential works in the field of Automation and Artificial Intelligence (AI). These works have made significant contributions to the development, understanding, and application of AI technology. Below, we discuss each of these citations, their authors, and the impact they have had on the field:

Table 3. Citations Analys

Citation	Authors & Years	Title
56593	[21]	Artificial intelligence a modern approach
4118	[22]	Artificial intelligence: structures and strategies for complex problem solving
3801	[23]	Why are there still so many jobs? The history and future of workplace automation
3506	[24]	Logical foundations of artificial intelligence
3365	[25]	High-performance medicine: the convergence of human and artificial intelligence
2644	[26]	Bayesian artificial intelligence

2384	[27]	Automating the design of graphical presentations of relational information
2349	[28]	Automated detection of COVID-19 cases using deep neural networks with X-ray images
2163	[29]	Artificial intelligence in radiology
1997	[30]	Artificial intelligence in service

These citations represent a diverse range of AI-related topics, from foundational principles and problem-solving strategies to the application of AI in specific domains such as healthcare, data visualization, and service industries. They have collectively shaped the

field of Automation and AI, contributing to its development, research, and practical applications. Researchers and practitioners continue to build upon these influential works to advance the field further.

Table 4. Keywords Analys

Most occurrences		Fewer occurrences	
Occurrences	Term	Occurrences	Term
61	Approach	20	Implication
59	Robot	19	Tourism
58	Robotic process automation	19	Internet
56	Model	18	Home automation
42	Technique	17	Aspect
39	Detection	16	Construction
32	Control	14	Robotics
31	Service automation	13	Travel
29	Deep learning	11	Automating
28	Decision	10	Hospitality

The term occurrences listed in this section provide insights into the prevalence of specific terms within the field of Automation and Artificial Intelligence (AI). We will discuss the terms with the most occurrences and those with fewer occurrences to understand their significance and relevance in the field:

Most Occurrences:

): The term "approach" appears frequently, suggesting a strong emphasis on various methodologies, techniques, and approaches within AI research. Researchers in the field are likely exploring different approaches to problem-solving, machine learning, and AI system design. The term "robot" is highly prevalent, reflecting the significance of robotics in AI research and applications. This suggests a focus on the development, design, and use of robots in various industries and domains. "Robotic process automation" is another highly

occurring term, highlighting the growing interest in automating repetitive tasks and processes using AI-driven robotic systems. This term is particularly relevant in business and industry settings. The term "model" indicates a focus on AI modeling techniques, which play a crucial role in machine learning and predictive analytics. Researchers are likely developing and evaluating AI models for various applications. "Technique" signifies the exploration of various AI techniques and methodologies. This suggests a diverse range of research into AI methods and approaches for solving complex problems.

Fewer Occurrences:

"Implication" is less frequently mentioned but is likely associated with research exploring the implications and consequences of AI adoption, including ethical, societal, and economic considerations. The term "tourism" indicates a relatively specialized area of AI research, possibly

related to the application of AI in the tourism and travel industry. While "Internet" is a common term, its presence in this context suggests research related to the impact of AI on Internet technologies, including IoT and online services. "Home automation" is likely associated with the integration of AI in smart home systems, reflecting the growing interest in automating household tasks and enhancing residential environments.

"Aspect" may be used in research discussing various aspects of AI, such as ethical aspects, technical aspects, or specific application domains. The presence of "construction" may indicate research on AI applications in the construction industry, potentially focusing on automation and efficiency in construction processes. While "robotics" is a relevant term, its fewer occurrences suggest a specific focus on robotics-related research within the broader field of AI. "Travel" may be associated with AI applications in the travel and tourism sector, including travel planning, booking, and customer service. "Automating" likely refers to research exploring the automation of tasks and processes using AI technologies, emphasizing efficiency and productivity gains. The term "hospitality" suggests research related to the application of AI in the hospitality industry, which includes hotels, restaurants, and customer service.

These term occurrences reflect the diversity of research areas and topics within Automation and AI. While some terms are highly prevalent, indicating core areas of research and development, others with fewer occurrences may represent specialized or emerging areas of interest within the field. Researchers and practitioners draw from this varied terminology to address a wide range of challenges and opportunities in AI and automation.

CONCLUSION

The complex network of interdisciplinary research in the rapidly developing fields of automation and artificial intelligence has been made clear by this bibliometric analysis. The exhibition has

emphasized the integration of knowledge across disciplines and highlighted the cooperative nature of scholars from many fields. Notable writers and foundational works have been acknowledged, indicating the long-lasting influence of important contributions. The focus of research has shifted in recent years, with machine learning, ethics, and healthcare applications taking center stage. The science convergence has been graphically portrayed by the VOSviewer visualizations, which also highlight the importance of interdisciplinary hub development and cross-disciplinary collaboration. The conclusions drawn from this investigation are important for industry stakeholders as automation and artificial intelligence (AI) continue to revolutionize the industry. Improved interdisciplinary cooperation promises creative solutions, and responsible development is guided by ethical considerations. The healthcare industry is ripe for revolutionary advancements, and schools can customize their curricula to equip their student body for the AI-driven future.

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