Development Study Posthumanism: Bibliometric Analysis Based on Scopus Data 1967-2024

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Abstract. This study examines the development of posthumanism through a bibliometric approach to identify prevailing research trends and future directions. Posthumanism is increasingly viewed as a concept capable of reshaping human roles within the economic sector, particularly in the world of work. The data for this study were obtained from the Scopus database, comprising 4,098 documents, of which 1,837 publications from 1967 to 2025 were analyzed. The results show a significant rise in publications and citations related to posthumanism, with major contributions originating from countries such as China and Japan. The findings also indicate that advances in robotics substantially influence human existence. In addition, this study identifies the most influential authors and keywords within the domain of posthumanism. These insights are expected to encourage future researchers to pursue further innovation and to explore more focused research areas within the field.

Keywords: Posthumanism, Bibliometric, R, Biblioshiny, Scopus

1. Introduction

Technological progress has transformed the way humans perceive their own existence. As technology becomes increasingly advanced and deeply integrated into daily life, it reshapes organizational cultures and work practices that now prioritize efficiency and effectiveness [1]. The widespread adoption of technology, while offering many advantages, has also contributed to a shift in how humans are valued often reducing human roles to merely functional or economic components [2]. This transformation has led to the emergence of posthumanism, a concept that questions traditional understandings of humanity and the boundaries between humans and technology [3],[4].

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Posthumanism is commonly defined as an approach that examines how human capacities may be extended through advanced technologies [4]. This concept aligns with broader societal shifts influenced by rapid developments in artificial intelligence and biotechnology, fields that increasingly blur the distinction between human and non-human entities [5]. Some scholars argue that the human body, from a biological standpoint, was never designed to adapt to the scale of technological transformation occurring today. Even the evolution of language is sometimes interpreted as an early expression of posthuman capability [6].

Pepperell identifies three core principles of posthumanism. First, posthumanism does not imply the extinction of humanity but rather the collapse of a worldview that positions humans at the center of the universe. Second, evolution is understood as a dynamic process shaped not only by genetic inheritance but also by tools, cultural developments, technological systems, and modes of existence. Third, posthumanism evaluates how humans relate to the environment, animals, and other non-human entities, raising issues of ethics, justice, interspecies interaction, social structures, and interdisciplinary inquiry. [7]

Posthumanism describes a condition in which human life becomes increasingly inseparable from technology [8].As a result, conventional understandings of what it means to be human have undergone significant transformation. Advances in digital communication reshape interaction patterns, while the convergence of biological and technological systems complicates the distinction between natural and artificial forms of existence. [8]

In recent years, posthumanism has gained substantial attention across various disciplines, including human resource management [8].Traditional HR approaches centered on optimizing productivity and managing people are increasingly challenged by rapid technological advancements and evolving work dynamics [9].Posthumanism provides an alternative lens for examining how artificial intelligence and robotics reshape HR structures, decision-making processes, and the future of human labor [10].

According to Garry and Harwood, the rise of posthumanist technologies generates both new opportunities and new forms of inequality within the labor market [13].Trends such as automation, artificial intelligence, and deeper technological integration across industries are transforming the competencies required in future professions. Through technological augmentation, human capabilities including physical power, cognitive performance, and physiological resilience may be enhanced. Consequently, fields such as medical technology, biotechnology engineering, AI development, and big data analytics are expected to grow substantially [14].

In line with that research by Tao et al., titled “A bibliometric analysis of human reliability research,” Overall, there are 1,463 documents indexed on human reliability research published between 1984 and 2018. Documents This study involves 3,287 authors, who are spread across 533 journals from 71 countries and includes contributions from 1,364

institutions. The study on human sophistication shows a significant increase, rising from only 4 articles in 1984 to 137 articles in 2018. However, the study focuses solely on the analysis of human resource sophistication, system excellence, error identification, and human performance [15].

Earlier studies have expressed concern regarding the impact of posthumanism on human life, particularly its potential to alter fundamental paradigms of human existence. Responding to these issues, this study aims to examine the extent of academic exploration on posthumanism and trace its development within the literature.

This study aims to examine academic discourse on posthumanism through a bibliometric literature review [10].Specifically, the research seeks to: (1) assess bibliometric performance including publication trends, contributing countries, institutions, authors, journals, and subject areas and (2) identify dominant themes and emerging trends within the literature. The results are presented through visualizations such as charts and tables for clarity. By analyzing relevant keywords, this study maps the conceptual structure of posthumanism and highlights the direction of its research development. Overall, this work is intended to contribute to academic understanding and provide a comprehensive overview of research progress in the field.

2. Literature Review

Posthumanism

The term “posthumanism” emerged as a counter-movement to earlier dominant perspectives such as theocentrism and anthropocentrism. Theocentric thought places God at the center of the natural universe [15] ,while anthropocentrism positions humans as the primary reference point [16]. Over time, both views were perceived as limiting the advancement of scientific and civilizational progress. As a result, new concepts and definitions began to take shape, culminating in what is now recognized as posthumanism [17] This perspective is considered increasingly relevant to contemporary life, particularly in economic, social, cultural, and political contexts.

The foundational discourse of posthumanism emphasizes the inherent limitations of human ability and the necessity of enhancing these capacities through technological integration [18]. Such integration is believed to strengthen physical, biological, cognitive, and linguistic dimensions of human life. Historically, posthumanist ideas can be traced to influential philosophical works such as Nietzsche’s concept of “God is Dead” [19], Descartes’ rationalist approach in “Discourse de la Méthode” [20], and Heidegger’s ontological investigations in “Being and Time” [21]. These contributions collectively challenged human-centered paradigms and supported the evolution of scientific and philosophical inquiry. Thus, posthumanism can be

understood as both an ontological outlook and a pragmatic approach aimed at shaping an unrestricted and evolving civilization.

Pepperell identifies three major components of posthumanism [22]. First, posthumanism does not signify the end of humanity, but rather the end of a worldview that places humans at the center of the natural universe. Second, it redefines evolution as a process influenced not only by genetic factors but also by cultural, technological, and existential dimensions. Third, posthumanism addresses the ethical and relational aspects of how humans interact with the environment, animals, and other non-human entities, linking these relationships to broader questions surrounding justice, interspecies communication, social systems, and interdisciplinary inquiry.

Supporters of posthumanism assert that societal challenges can be resolved more effectively through the integration of human capacities with technological advancement [23]. This argument is reinforced by Haraway's influential cyborg concept introduced in the late 1970s and early 1980s, which imagines a hybrid entity composed of both human and machine elements [24]. When applied to advancements in robotics and artificial intelligence, this concept suggests that the workplace of the future will increasingly consist of human employees working alongside robots and AI-based assistants [25].

As social interaction remains a core element of organizational life, new guidelines must be formulated to regulate interactions between human and non-human agents. The growing reliance on robots and AI is likely to introduce a new form of workplace diversity. Understanding how these non-human participants affect organizational performance, employee experience, and diversity management practices becomes vital in this emerging environment.

If robots are used to replace rather than support human workers, employees may demand designated "robot-free" zones to preserve specific forms of human-centered work. Such boundaries aim to define which tasks should or should not be delegated to advanced technologies. These ethical and practical considerations will become essential in future studies that explore the role of technology and the opportunities and challenges it brings to the workplace. This development also highlights a crucial issue: how future workspaces and job functions will evolve in an increasingly data-driven and technologically mediated world.

3. Research Methods

This study employs a quantitative descriptive design combined with a bibliometric approach. Bibliometric analysis serves as a contemporary method for examining extensive scientific datasets, enabling researchers to detect developments within specific domains and to identify emerging areas of study [26]. The primary analytical tool utilized in this research is the R Bibliometric application, which provides broad analytical flexibility and advanced capabilities. R facilitates various forms of complex statistical processing and customizable visualizations

tailored to the needs of the research. It also offers comprehensive data-handling features, supports multiple data formats, and integrates seamlessly with other statistical packages, resulting in more detailed and sophisticated analyses [23].

The bibliographic dataset analyzed in this study was obtained from the Scopus database, consisting of 4,098 documents. Scopus is widely recognized as the largest multidisciplinary indexing platform for scientific literature, particularly in the social sciences, and is frequently utilized as a primary source for quantitative research analysis [2], [7].

The bibliometric data used in this study were retrieved from Scopus on July 13, 2024, using a targeted keyword query: TITLE-ABS-KEY (“Human” AND (“Digitalist” OR “Technology” OR “Augmentation Technology” OR “Cybernetics”) AND (“Transhumanism” OR “Superman” OR “Robot man” OR “Human machine” OR “Posthumanism” OR “Biohacking” OR “Extended Humanity” OR “Technological Singularity” OR “Human Enhancement” OR “Augmented Human” OR “Enhanced Humans” OR “Cyborgs” OR “Posthuman” OR “Transhuman” OR “Bio-augmentation” OR “Future Human”)), restricted to article documents, journal sources, and English-language publications. The resulting dataset was downloaded in CSV format for further processing using VOSviewer and Biblioshiny in RStudio. VOSviewer (VV) is a software tool designed to visualize bibliometric networks and map bibliographic elements such as authors, titles, and journals [28]. In addition, Biblioshiny provides a web-based interface for Bibliometrix, enabling analytical functions such as generating topic dendrograms, conceptual maps, and trend visualizations [29].

4. Results and Discussion

This section presents the principal findings derived from the descriptive and inferential analyses conducted within the posthumanism domain. As previously outlined, the study examines several core dimensions, including the most influential authors, the most frequently cited works, the leading journals in terms of research dissemination, the geographical distribution of scientific production, the conceptual structure of the field, institutional affiliations, and the interconnections that shape scholarly networks in this area. Together, these components provide a comprehensive assessment of the current landscape of posthumanism research and offer insights into emerging trends, persistent challenges, and potential avenues for future scholarly development.

General Information on the Domain

This section provides a comprehensive overview of the general publication landscape in the posthumanism domain (Figure 1). Covering the period from 1967 to 2024, the analysis encompasses 1,837 sources and a total of 4,098 peer-reviewed articles. The average document age of 6.81 years indicates that the field is relatively young yet experiencing continuous

development and scholarly expansion.

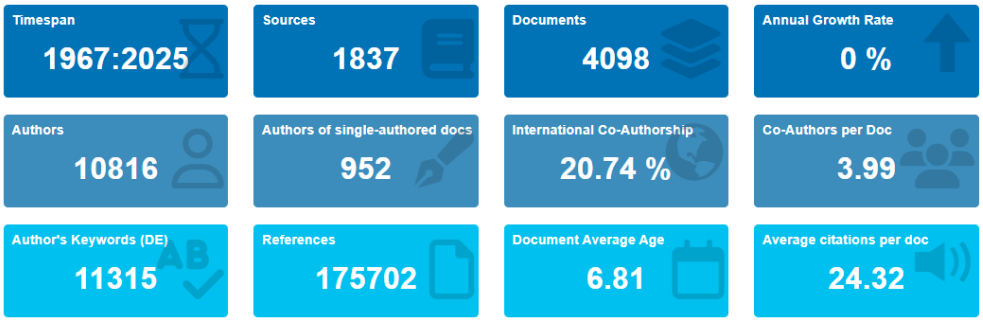

Figure. 1. General information on the posthumanism domain.

The domain exhibits strong academic impact, with an average of 24.32 citations per document. The corpus contains 175,702 cited references, demonstrating substantial theoretical diversity and a broad foundation of scientific support. The dataset also includes 17,933 additional keywords and 11,315 author-assigned keywords, reflecting the wide thematic scope and conceptual richness of posthumanism research. A total of 10,816 authors contributed to these publications, representing extensive international participation and collaboration.

Collaboration patterns further reveal a robust global research network. Each publication involves an average of 3.99 authors, while international co-authorship accounts for 20.74% of all documents. Although collaborative works dominate, individual scholarship remains visible through the 952 single-authored publications recorded during the period.

Overall, the findings affirm that posthumanism constitutes a dynamic, rapidly evolving, and increasingly collaborative field. The strong involvement of national and international authors has contributed significantly to the exponential growth of scientific output within this research domain.

Annual Scientific Production in the Domain

The trajectory of scientific output in the posthumanism domain from 1967 to 2025 demonstrates a substantial and sustained growth pattern. During the early phase (1967–1976), scholarly attention to the topic was minimal, with annual publication counts fluctuating between zero and one article. A gradual increase emerged between 1977 and 1982, with certain years producing up to five articles. The period from 1983 to 1995 marked a more consistent rise, including notable peaks such as the publication of eight articles in both 1984 and 1985, eleven articles in 1986 and 1988, and a significant peak in 1994 with 21 publications.

From 1996 to 2005, the upward trend became increasingly stable, with annual output ranging from the low to high twenties and reaching 29 articles in both 1995 and 2006. A more pronounced expansion occurred from 2006 to 2014, culminating in 88 articles in 2014. The period between 2015 and 2020 reflected accelerated academic engagement, with publication counts rising sharply from 114 articles in 2015 to 351 in 2020. This growth intensified between 2021 and 2023, with annual outputs of 394, 509, and a peak of 568 articles, respectively. Although 2024 experienced a decrease to 426 articles, the volume remained significantly higher than in earlier decades. Data for 2025 remain incomplete, as only one article has been recorded at the time of extraction.

Overall, these patterns reveal a robust escalation of scholarly interest in posthumanism, particularly from the mid-2000s onward. The notable surge from 2015 to 2023 indicates that posthumanism has become an increasingly central subject of contemporary academic discourse. The minor decline observed in 2024 may reflect temporary fluctuations or incomplete reporting, underscoring the need for ongoing monitoring to determine whether this represents a transitional phase or a broader stabilization trend.

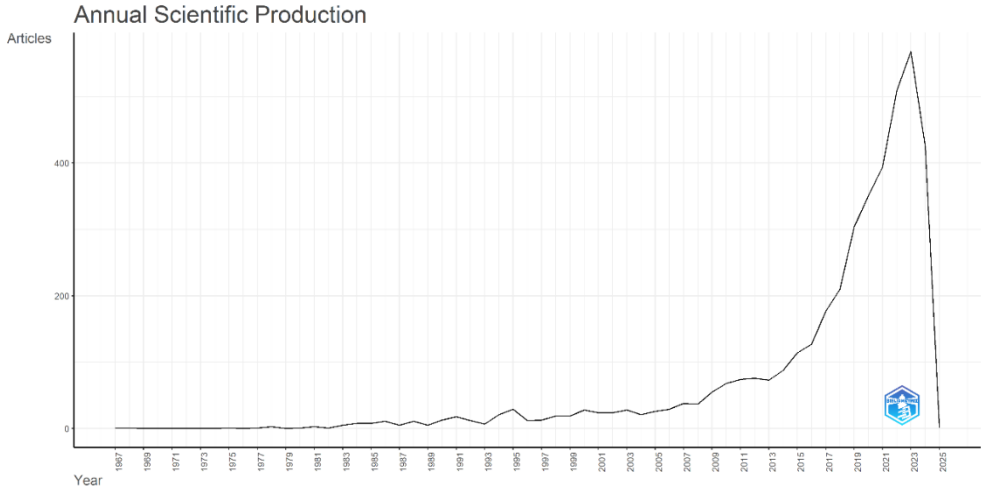

Figure. 2. Publications in the posthumanism domain from the 1967s to the present.

Several factors may explain the pronounced growth over the past decade, including increased research funding, heightened recognition of the field's relevance, rapid technological advancement, and a growing global community of researchers [27]. The contrast between the average annual output of 0.4 articles during 1967–1977 and 297 articles during 2014–2024 confirms the field's accelerated expansion. The available evidence suggests that publication activity in posthumanism is likely to continue rising as scholarly interest and research investment expand further [27].

Relevant Sources in the Domain

The distribution of publication sources within the posthumanism domain demonstrates considerable breadth and diversity, as illustrated in Figure 3. Across approximately 1,837 identified sources, ten journals emerge as the most influential based on publication volume. Nano Energy ranks first with 67 articles, followed by IEEE Access with 60 articles. Other major contributors include ACS Applied Materials and Interfaces (51 articles), Applied Sciences (Switzerland) (46 articles), and Advanced Functional Materials (45 articles). Additional high-output journals such as Sensors (Switzerland) and Sensors contribute 39 and 37 articles respectively, while Advanced Materials Technologies, IEEE Sensors Journal, and AI and Society complete the top ten with 30, 29, and 26 articles. Collectively, these data emphasize the centrality of advanced technologies, applied materials, and sensor innovation in shaping posthumanism scholarship, reflecting significant theoretical progress as well as practical application within the field.

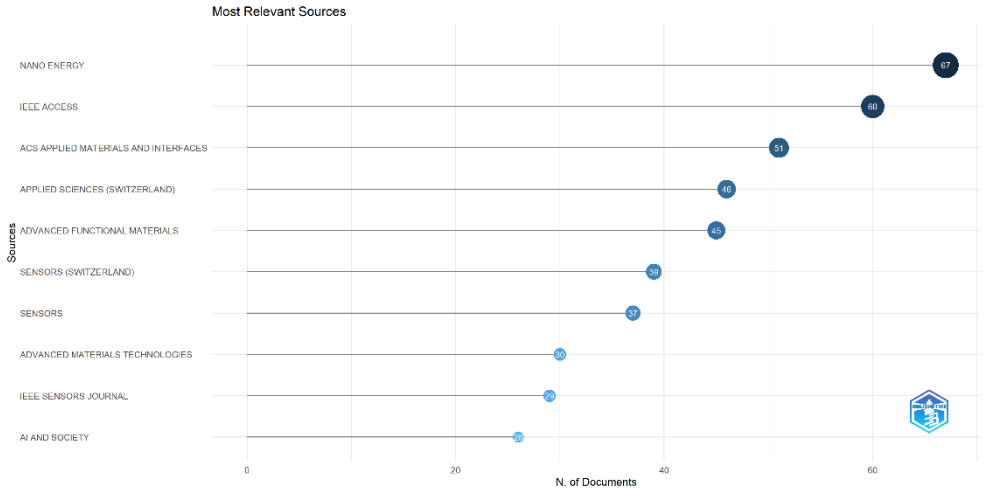

Figure. 3. Distribution of sources in posthumanism .

Among the sources, Nano Energy and IEEE Access serve as the primary platforms for disseminating high-impact research, both occupying Q1 positions in the SCImago Journal Rankings. In 2023, Nano Energy recorded an SJR of 4.69, while IEEE Access reported an SJR of 0.96, underscoring the reputational strength and scholarly influence of these journals.

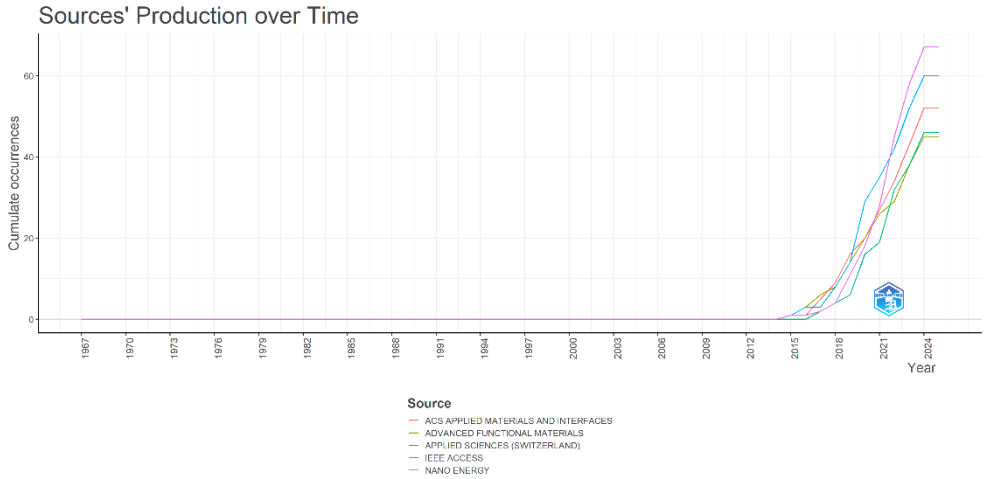

Figure. 4. Chronological timeline of the research production of the most relevant sources.

Figure 4 displays the development of the number of articles published by several main sources in the posthumanism domain from 1967 to 2025. From this data, it can be seen that there were no publications related to posthumanism from these sources until 2015. A significant increase in the number of publications began to be seen since 2015, with each source starting to publish one article per year.

Figure 4 further illustrates the chronological expansion of research output from these leading sources between 1967 and 2025. Prior to 2015, publications related to posthumanism were virtually absent in these journals. Beginning in 2015, however, consistent annual contributions emerged across multiple sources. The upward trajectory became more pronounced in subsequent years. For instance, in 2019, Nano Energy produced 11 articles, while IEEE Access and ACS Applied Materials and Interfaces contributed 14 and 16 articles, respectively. This growth accelerated during 2020–2024, with IEEE Access reaching 29 publications in 2020 and Nano Energy and Advanced Functional Materials producing 18 and 20 articles, respectively. By 2024, Nano Energy led with 67 publications, followed by IEEE Access with 60 and ACS Applied Materials and Interfaces with 52.

Overall, these findings demonstrate a substantial and sustained increase in source-level contributions to posthumanism research, particularly after 2015. The expansion reflects heightened scholarly attention to technological innovation, materials science, and human–technology interaction within this rapidly evolving domain.

Relevant Authors in the Domain

This section examines the leading authors contributing to the development of posthumanism research. As shown in Figure 5, Wang Y is identified as the most prolific author with 74

publications, followed closely by Liu Y with 65 articles and Li J with 64. Other notable contributors include Wang X (56 articles), Li Y (54), Wang Z (51), and Wang J (41). Additional authors such as Wang H, Wang ZL, and Wang L also demonstrate substantial scholarly involvement, each producing between 39 and 40 publications. These patterns indicate that a relatively concentrated group of highly productive authors plays a central role in advancing research within this domain.

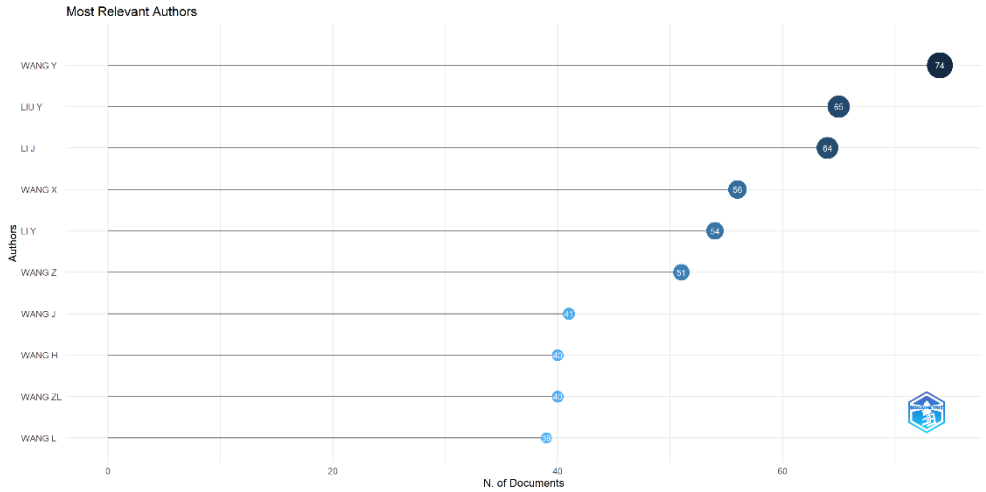

Figure 5. Distribution of the most prominent authors in each domain and their number of publications.

Figure 6 illustrates the longitudinal progression of author productivity as well as annual citation performance (TCpY). Li J, for example, experienced a sharp increase in scholarly output after 2020, publishing five articles in 2020 (receiving 231 citations), nine articles in 2021 (428 citations), and 16 articles in 2022 (514 citations). His subsequent productivity remained strong through 2023 and 2024. Similarly, Li Y has maintained consistent productivity since 2017, with a peak in 2023 when he produced 20 articles and received 184 citations. Liu Y has contributed significantly since 2013, with exceptional citation counts in early publications and continued activity through 2024.

Other prominent contributors include Wang H, whose productivity surged beginning in 2017, with citation peaks occurring in 2022, and Wang J, who recorded his highest impact in 2021 with 921 citations. Wang L reached peak influence in 2022 with 458 citations, while Wang Y has shown a steady upward trend in both publication volume and citation impact, particularly after 2021. Wang Z and Wang ZL also reflect strong scholarly influence, with Wang ZL recording an exceptional citation peak in 2018 with over 2,200 citations.

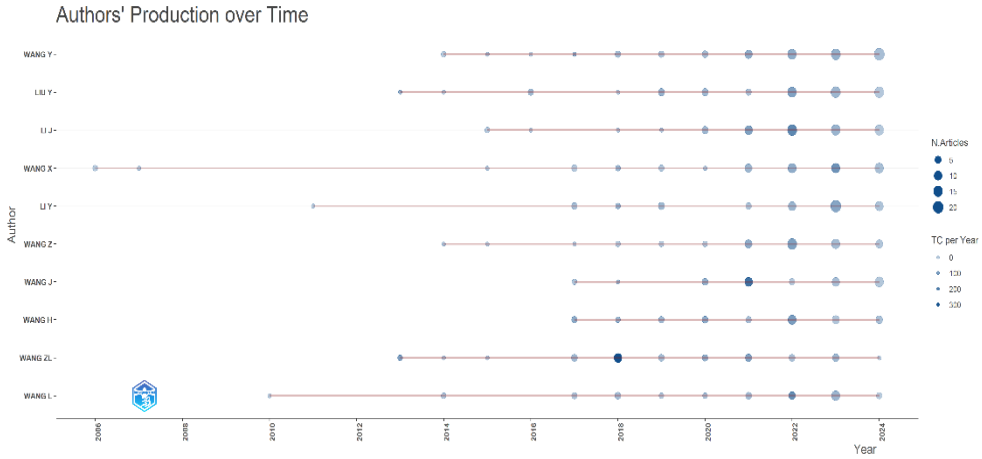

Fig. 6. Distribution of the most prominent authors in each domain and their number of publications.

Overall, the data highlight a marked rise in both productivity and impact among leading authors in posthumanism research. This upward trend reflects intensified global engagement with the field and underscores the substantial contributions of key scholars whose work has shaped the domain's theoretical and empirical development.

Most Productive Countries in the Domain

The country-level analysis of scientific productivity within the posthumanism domain (Figure 7) reveals a clear concentration of research output across several leading nations. China ranks as the most prolific contributor, generating 5,282 publications, followed by the United States with 2,843 publications. European countries also demonstrate substantial engagement, with Germany producing 753 publications, the United Kingdom contributing 673, and Italy adding 652 to the total corpus.

In addition to these leading contributors, several Asian countries—including South Korea (559 publications) and Japan (402 publications)—show notable levels of research activity. Australia, Spain, and India also present comparable levels of productivity, with 396, 393, and 392 publications, respectively.

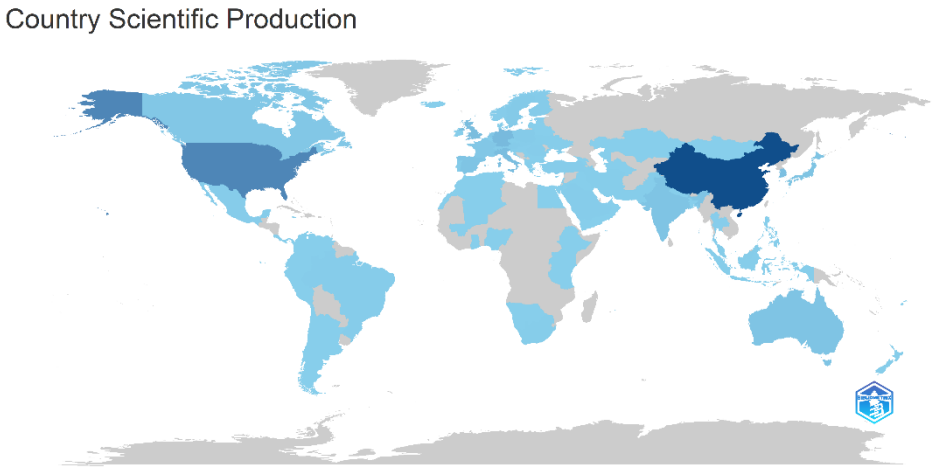

Figure 7. Contributions to the posthumanism segmented by countries.

Overall, the data indicate that research output in posthumanism is predominantly driven by countries in Asia, Europe, and North America, with China and the United States serving as the primary hubs of scientific advancement within this field.

Collaboration Between Countries - World Map

The global collaboration network in the posthumanism research domain, illustrated in Figure 8, demonstrates an extensive and internationally connected scholarly landscape. The most prominent collaborative relationship is between China and the United States, with a total of 128 joint publications. Significant partnerships are also evident between China and the United Kingdom (42 collaborations) and between China and Singapore (39 collaborations). The United States likewise maintains a strong research relationship with the United Kingdom, recording 37 collaborations.Additional cross-national collaborations further reinforce the global nature of posthumanism research. China maintains considerable scholarly engagement with Hong Kong through 35 co-authored publications. The United States collaborates extensively with Germany (34 collaborations), South Korea (28), and Canada (25). Within Europe, Germany shows balanced collaborative ties with both the Netherlands and the United Kingdom, recording 21

collaborations with each ffrequency 21.

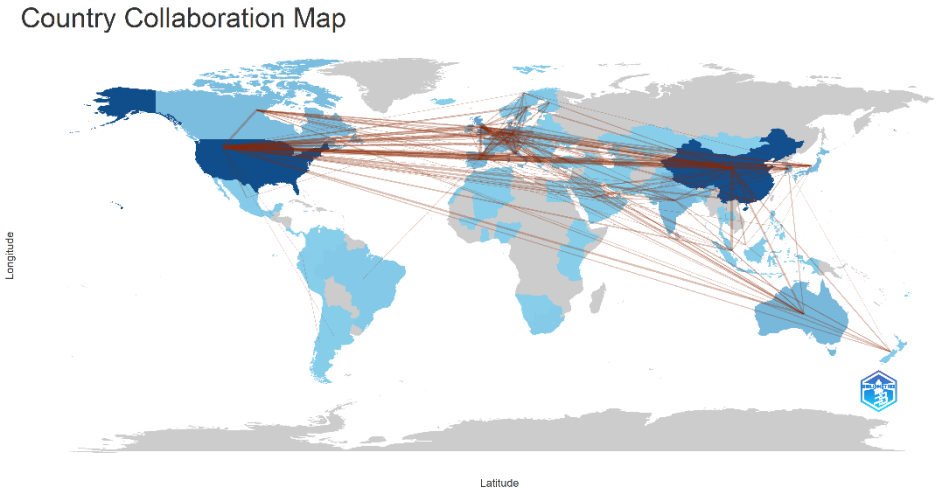

Figure 8. Relations between countries in the posthumanism and other international blocs.

Taken together, these patterns highlight the existence of a dense and globally distributed research network, in which China and the United States function as key collaboration hubs. The interconnectedness observed across Asia, Europe, and North America underscores the international scope and growing academic importance of posthumanism research.

Relationships Between Countries by Authors

The correspondence analysis of authorship within the posthumanism research domain (Figure 8) identifies two main publication categories: Single Country Publications (SCP) and Multiple Country Publications (MCP). SCP refers to articles produced exclusively within one country, while MCP reflects publications resulting from cross-national collaboration [27].

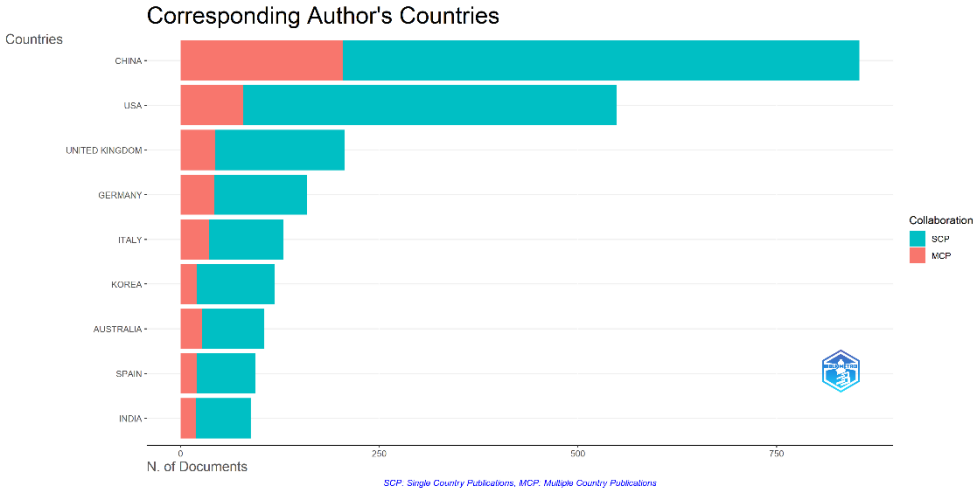

Figure 9. Documents segmented by single authors and authors from multiple countries.

Figure 9 illustrates the distribution of corresponding authors by country. China emerges as the most productive contributor, with 854 publications 650 categorized as SCP and 204 as MCP yielding an MCP ratio of 0.239, which reflects a substantial level of international engagement. The United States follows with 549 publications, comprising 470 SCPs and 79 MCPs, resulting in an MCP ratio of 0.144 and indicating a stronger emphasis on domestic collaboration compared to China.

The United Kingdom recorded 206 publications (163 SCPs and 43 MCPs), corresponding to an MCP ratio of 0.209. Germany produced 159 publications—117 SCPs and 42 MCPs—with an MCP ratio of 0.264, demonstrating a relatively high inclination toward international partnerships. Italy, with 129 publications (93 SCPs and 36 MCPs), achieved an MCP ratio of 0.279, the highest among the countries assessed.

Other countries also contribute meaningfully: South Korea (118 publications, MCP ratio 0.169), Australia (105 publications, MCP ratio 0.257), Spain (94 publications, MCP ratio 0.213), India (88 publications, MCP ratio 0.216), and the Netherlands (70 publications, MCP ratio 0.214). These figures suggest consistent and active participation in international research networks.

Collectively, the data indicate that China and the United States remain the leading contributors in terms of total research output in posthumanism. However, European countries particularly Italy, Germany, and the United Kingdom exhibit stronger international collaboration patterns, as reflected in their higher MCP ratios. This trend underscores the increasingly global nature of scholarly engagement in posthumanism and highlights the essential role of cross-border collaboration in the advancement of the field.

Conceptual Structure of the Domain

The conceptual structure of a research domain encompasses the collection of concepts, terminologies, relational patterns, and underlying principles that shape and explain the knowledge framework of that field. In this study, the conceptual structure of posthumanism is examined through author keywords and Keywords Plus, the latter being index terms generated by databases to refine document classification across research categories [27].

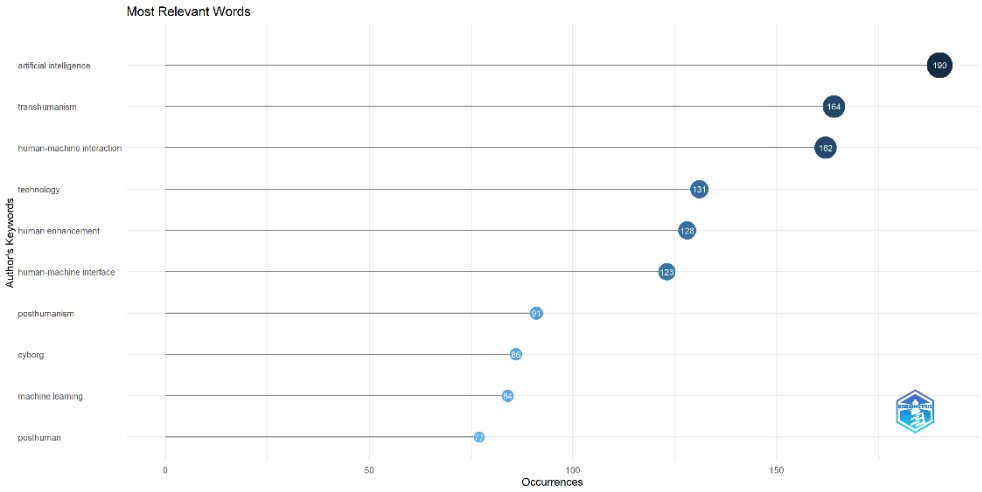

Figure 10. Keywords proposed by authors used in the posthumanism domain.

The analysis of author keywords (Figure 10) reveals several core themes underpinning posthumanism scholarship. “Artificial intelligence,” appearing 190 times, emerges as the most dominant term, reinforcing its role as a central axis of contemporary posthumanist discourse. “Transhumanism” (164 occurrences) and “human–machine interaction” (162 occurrences) follow closely, highlighting sustained scholarly attention to the integration of humans and machines as well as the broader aspirations of human augmentation. Additional frequently occurring terms such as “technology” (131), “human enhancement” (128), and “human–machine interface” (123) further emphasize the domain’s concentration on technological mediation and enhancement of human abilities.

Concepts such as “posthumanism” (91), “cyborg” (86), “machine learning” (84), and “posthuman” (77) also appear prominently, reflecting ongoing interest in technologically augmented identities and the philosophical dimensions of posthuman futures. Collectively, these patterns demonstrate that research in this domain is anchored in themes relating to artificial intelligence, human–machine collaboration, and technological enhancement.

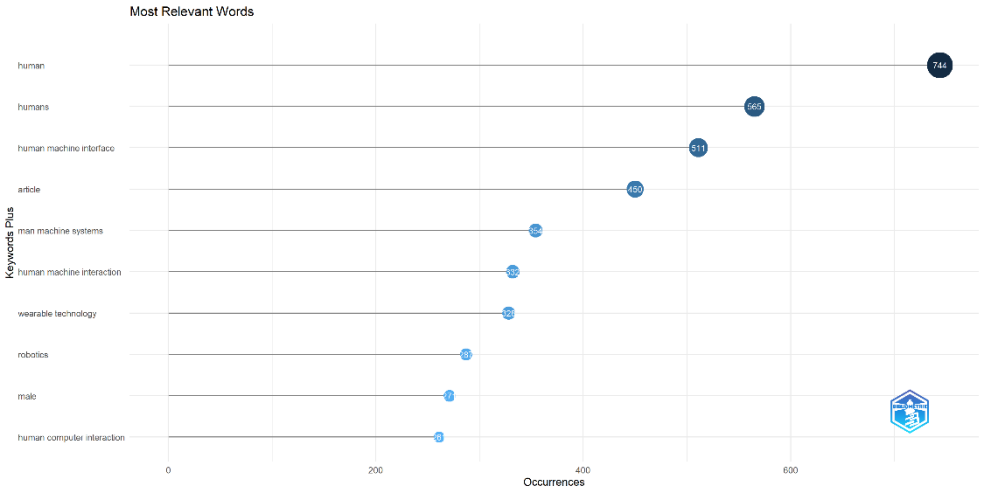

Figure 11. Keywords Plus used in the posthumanism domain.

Keywords Plus (Figure 11) provide additional insight into thematic emphases. The terms "human" (744) and "humans" (565) dominate the category, indicating that human-centered inquiry remains at the heart of posthumanist studies, even amid technological transformations. Strong representation of terms such as "human–machine interface" (511), "man–machine systems" (354), and "human–machine interaction" (332) underscores the field's deep engagement with interactive and systemic dimensions of human–technology relations.

Wearable technology (328 occurrences) and robotics (287 occurrences) also appear as central topics, suggesting active investigation into embodied technologies and robotic systems as elements shaping posthuman conditions. Meanwhile, the occurrence of "male" (271) and "human–computer interaction" (261) points toward specialized explorations involving gender perspectives and digital interfacing. Taken together, these findings confirm that posthumanism research is strongly oriented toward technological integration, interactive systems, and embodied enhancement, highlighting the multifaceted ways technology is reshaping human capabilities and environments.

Thematic Evolution of the Domain

The thematic evolution of research in the posthumanism domain, mapped in Figure 12, provides insight into how scholarly interests and conceptual priorities have shifted over nearly six decades. Using author keywords as the basis for analysis, the figure highlights the chronological transformation and diversification of research themes within the field.

During the 1967–2015 period, "human enhancement" served as a dominant theme. In the 2016–2020 period, this theme evolved into "human–machine interface," accompanied by the

emergence of “disability” (7 occurrences), indicating a shift toward examining technology-enabled interfaces relevant to disability studies. Additionally, the transition from “human enhancement” to “technology” during the same period supported by 46 occurrences of terms such as “transhumanism,” “ethics,” and related concepts reflects the increasing emphasis on ethical considerations surrounding human augmentation, as evidenced by a Weighted Inclusion Index of 0.78.

The theme “human–machine interface” displayed notable continuity from 1967 through 2020 (12 occurrences), illustrating sustained scholarly engagement with interaction models between humans and machines. Similarly, “human–machine interaction” persisted into the 2016–2020 period (23 occurrences) before transitioning into the broader and more technologically complex theme of “artificial intelligence” in 2021–2022, characterized by the frequent appearance of terms such as “automation,” “robots,” and “autonomy” (23 occurrences).

The progression from “technology” (2016–2020) to “artificial intelligence” (2021–2022) is further marked by emerging terms such as “cybernetics,” “embodiment,” and “human–machine communication” (48 occurrences), signaling a deepening focus on intelligent systems and embodied interaction. Meanwhile, the evolution of “wearable electronics” (2016–2020) into themes such as “triboelectric nanogenerators,” “flexible electronics,” and “energy harvesting” (25 occurrences) demonstrates substantial advancement in wearable and energy-responsive technologies.

More recent thematic developments (2023–2025) show continued expansion of “human–machine interaction” into refined subthemes, including “artificial intelligence,” “augmented reality,” and “neural networks,” reflecting increasing specialization and the integration of immersive and intelligent technologies into posthumanist inquiry.

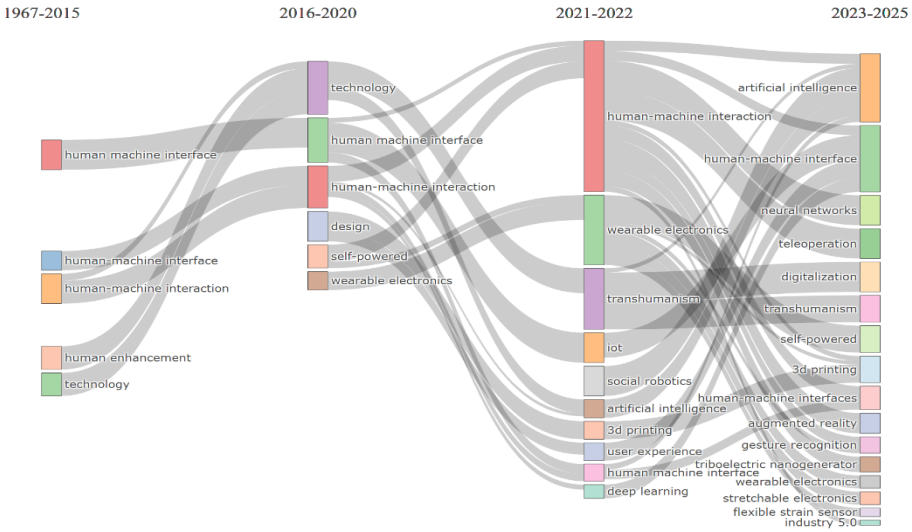

Fig. 12. Thematic evolution of the posthumanism domain in a 58-year range of publications.

Overall, these data illustrate how research topics in posthumanism have evolved and adapted to technological advances, with a strong focus on human-machine interaction, artificial intelligence, and wearable technology.

Thematic Map of the Domain

A thematic map provides a visual representation of the intellectual structure of a research field by identifying the principal themes that emerge from co-occurrence analyses. These themes are typically positioned within four quadrants—motor themes, niche (specialized) themes, emerging or declining themes, and basic themes—with their classifications determined by density and centrality metrics [27]. Figure 13 illustrates these thematic clusters using Keywords Plus, plotted according to their centrality (indicating the structural relevance of a theme within the field) and density (reflecting the internal development of that theme) [27].

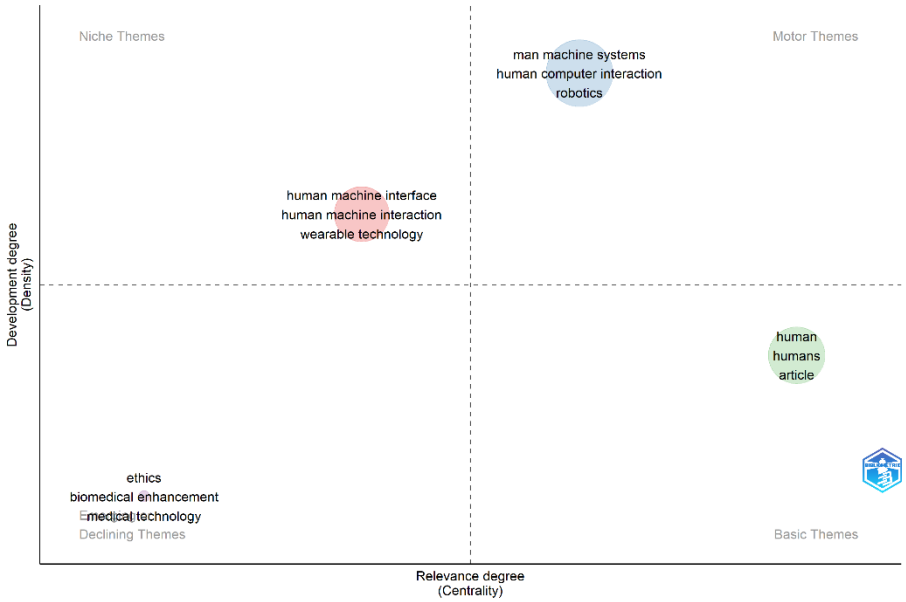

Figure 13. Thematic map of the posthumanism domain.

The thematic map for posthumanism reveals two dominant clusters: "human–machine interface" and "man–machine systems." The "human–machine interface" cluster encompasses themes such as human–machine interaction, wearable technologies, and wearable sensors. This cluster highlights technological developments that enable increasingly seamless interaction between humans and machines, including advancements in nanogenerators, flexible electronics, and Internet of Things (IoT) systems. Additional terms such as electrodes, triboelectric technologies, and intelligent robotics further emphasize innovation aimed at improving adaptability and responsiveness in technological systems.

The second major cluster, "man–machine systems," includes research areas such as robotics, human–computer interaction, and artificial intelligence. This cluster underscores strong research activity in automation, virtual reality, machine learning, and pattern recognition. Topics like electromyographic signal processing, gesture recognition, and brain–computer interfaces signify a growing interest in enhancing human communication with computer-based and robotic systems. Themes related to control systems, task analysis, and technological development suggest an emphasis on optimizing the performance and practical application of integrated human–machine systems across diverse contexts.

Overall, the thematic map demonstrates that research in posthumanism is heavily oriented toward technologies that deepen the integration of humans and machines. These themes collectively reflect a sustained scholarly focus on expanding human capabilities through wearable systems, intelligent automation, and advanced human–machine interfaces.

5. Conclusion

This study concludes that posthumanism has undergone substantial growth over the past several decades, particularly in discussions concerning human resources and technological transformation. The bibliometric evaluation of 4,098 documents published between 1967 and 2024 reveals a pronounced escalation in both the volume of scholarly output and citation frequency, with China and Japan emerging as the most prominent contributors. These trends underline the increasingly pivotal role of technology especially robotics and intelligent systems in reshaping human functions, competencies, and positions within economic structures and the contemporary labor market. Furthermore, the identification of dominant authors, recurring keywords, and thematic concentrations may serve as a foundation for future research, encouraging more focused and innovative explorations within the field.

Although this study successfully maps the evolution, trajectory, and thematic landscape of posthumanism, several limitations should be acknowledged. The exclusive reliance on the Scopus database presents a potential constraint, as relevant publications indexed elsewhere may not be captured. Additionally, the research predominantly adopts a quantitative approach, leaving deeper qualitative dimensions such as experiential, cultural, and philosophical implications of posthumanist developments less explored. Future studies are therefore encouraged to broaden their data sources by incorporating additional bibliographic databases and to integrate qualitative methodologies for a more comprehensive perspective. Exploring ethical, social, and policy-related repercussions of technological integration into human life will also be essential in addressing the challenges and complexities arising from the accelerating progress of posthumanism.

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