Bibliometric assessment of the intersection between biotechnology and additive manufacturing

Evaluación bibliométrica de la intersección entre la biotecnología y la fabricación aditiva

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Key Handbooks

The research makes a significant contribution to science and technology by offering a systematic bibliometric analysis of the emerging field that integrates biotechnology and additive manufacturing. Using recognised databases such as Scopus and Web of Science, the study quantifies scientific output, identifies trends, key players and areas of greatest impact. From a technological perspective, the field's focus on biomedical applications, tissue engineering, biomaterials, and artificial organs is noteworthy, highlighting the strategic role of additive manufacturing as an innovation-enabling technology. To apply the results to the generation of universal knowledge, it is essential to understand the interdisciplinary nature of the area, where biological fundamentals, experimental variables, and technological performance criteria converge. The correct interpretation of bibliometric indicators—such as citations, collaboration networks, and keyword co-occurrence—allows the findings to be extrapolated to other scientific contexts. The use of visualisation tools such as VOSviewer reinforces the objectivity of the analysis and facilitates the identification of knowledge gaps and research opportunities. The conclusions point to sustained and dynamic growth in the field, with collaboration networks that remain fragmented. Opportunities are identified to strengthen international cooperation, integrate sustainability criteria, regulation and material properties, and consolidate lines of research that increase scientific and technological impact on a global scale. The authors record the following citations in Google Scholar in 2025: González-Sosa [16], Ávila-Soler [12], Zavala-Osorio [2], and Hernández-Rodríguez [2]. The first three authors are part of the National System of Researchers at Level I, and the last two co-authors have PRODEP profiles, all affiliated with federal public institutions in Mexico. The most frequently used keywords are: conceptual and bibliometric foundations, biotechnological aspects, experimental aspects, and technological applications associated with additive manufacturing.

Area: Promotion of frontier research and basic science in all fields of knowledge

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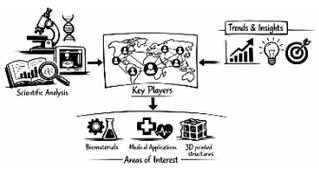
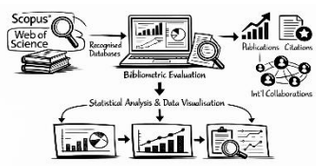
Abstract

This work analyses and quantifies scientific output in an emerging field that combines two areas, identifying trends, key players and areas of interest to guide future research. Bibliometric evaluation based on data from recognised databases such as Scopus and Web of Science is used, employing statistical analysis and visualisation to examine publications, citations, international collaborations and keywords over the last decade. This methodology offers an objective and comprehensive view of the field, enabling the detection of knowledge gaps and supporting research decisions. The results show sustained growth in scientific production, with leading countries and institutions and a trend towards biomedical and tissue engineering applications. Emerging areas include the use of biotechnology in additive manufacturing of biomaterials and artificial organs. The bibliometric evaluation reflects a growing interest in strengthening international collaborations and multidisciplinary approaches to assess real impact and innovation.

Bibliometric assessment of the intersection between biotechnology and additive manufacturing

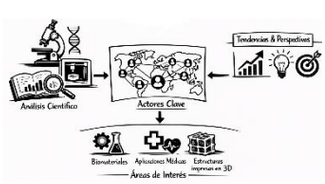
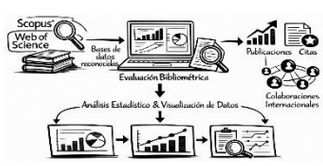
Objective	Methodology	Contribution
 Analyse and quantify scientific output at the intersection of biotechnology and additive manufacturing, identifying trends, key players and areas of interest to guide future research.	 It consist of a bibliometric evaluation based on data from recognised databases such as Scopus and Web of Science, using statistical analysis and data visualisation to examine publications, citations and international collaborations.	 It aims to provide an objetive and comprehensive overview of this emerging field, identifying knowledge gaps and facilitating strategic decisions to promote international collaborations and multidisciplinary approaches in this area of innovation.

Bibliometrics, Biotechnology, Additive manufacturing

Abstract.

Este trabajo analiza y cuantifica la producción científica en un campo emergente que combina dos áreas, identificando tendencias, actores clave y áreas de interés para guiar futuras investigaciones. Se emplea evaluación bibliométrica basada en datos de bases reconocidas como Scopus y Web of Science, utilizando análisis estadísticos y visualización para examinar publicaciones, citas, colaboraciones internacionales y palabras clave en la última década. Esta metodología ofrece una visión objetiva y completa del campo, permitiendo detectar brechas de conocimiento y apoyar decisiones de investigación. Los resultados muestran un crecimiento sostenido en la producción científica, con países e instituciones líderes y una tendencia hacia aplicaciones biomédicas y de ingeniería de tejidos. Áreas emergentes incluyen el uso de biotecnología en fabricación aditiva de biomateriales y órganos artificiales. La evaluación bibliométrica refleja un interés creciente para fortalecer colaboraciones internacionales y enfoques multidisciplinarios, para evaluar el impacto real y la innovación.

Evaluación bibliométrica de la intersección entre biotecnología y manufactura aditiva

Objectivo	Metodología	Contribución
 Analizar y cuantificar la producción científica en la intersección de la biotecnología y la manufactura aditiva, identificando tendencias, actores clave y áreas de interés para orientar futuras invesgaciones.	 Consiste en una evaluación bibliométrica basada en datos de bases reconocidas como Scopus y Web of Science, empleando análisis estadísticos y visualización de datos para examinar publicaciones, citas y colaboraciones internacionales.	 Radica en ofrecer una visión objetiva y completa del campo emergente, identificando brechas de conocimiento y facilitando decisiones estratégicas para promover colaboraciones internacionales y enfoques multidisciplinarios en esta área de innovación.

Bibliometría, Biotecnología, Manufactura aditiva

Introduction

Bibliometric evaluation of the intersection between biotechnology and manufacturing allows for quantitative analysis of scientific output in this emerging field, identifying trends and key areas of innovation. This approach is fundamental to understanding how these disciplines converge and contribute to technological and scientific advancement. It facilitates decision-making in research, investment, and scientific policy.

Its added value lies in offering an objective, systematic view of the impact and evolution of publications, allowing patterns of collaboration, the impact of authors and institutions, and areas of greatest development to be identified. Unlike qualitative methods, bibliometrics provides accurate and up-to-date data that supports more informed research and development strategies. It also helps identify knowledge gaps and future opportunities for innovation.

This assessment focuses on analyzing metrics such as citation index, scientific output and collaboration networks, using statistical analysis and visualization tools. The central hypothesis is that the integration of biotechnology and manufacturing is growing rapidly, driven by technological advances and market demands, which may be reflected in specific patterns of publications and collaborations.

The following paragraphs mention fundamental aspects of researchers who have conducted bibliometric analysis or evaluation in different fields of science, involving biotechnology and advanced manufacturing.

[Ben Said et al., 2025] provides a comprehensive overview of recent advances in additive manufacturing, highlighting emerging technologies and their applications in various sectors. Analyses the technical challenges and opportunities facing these innovations to improve efficiency and accuracy in production. The authors also explore future trends, pointing out promising areas for research and development. This work is a key reference for understanding the current state and prospects of additive manufacturing.

The article by [Gregorio-Chaviano et al., 2020] conducts a bibliometric analysis of Latin American scientific output related to COVID-19, highlighting the importance of research in the region during the pandemic. They identify a significant increase in the number of publications since the start of the health emergency, demonstrating a joint effort by Latin American countries to generate knowledge. There is greater participation by academic and health institutions, as well as a preference for relevant national and international journals. The study also highlights predominant subject areas, such as epidemiology, clinical care, and control strategies. It also highlights the uneven distribution among countries, with Brazil and Mexico leading in terms of production volume. The analysis emphasizes the need to strengthen regional collaboration and improve the visibility of Latin American research in the global context.

Bibliometrics, as highlighted in the analysis by [Amalakanti & Jillella 2026], is a fundamental tool for evaluating and understanding trends in scientific research across various disciplines. In the context of viral vectors for neuroregeneration, this methodology allows for the identification of emerging areas, the evaluation of researcher productivity, and the optimisation of resources. It facilitates strategic decision-making in the allocation of funds and the establishment of research priorities. The importance of bibliometrics lies in its ability to promote more efficient and collaborative research, driving significant advances in science and medicine. Its use contributes to strengthening scientific development in different fields, benefiting the academic and social community in general.

[Díaz-Martínez et al., 2024] conducts a bibliometric analysis of the importance of additive manufacturing in the context of Industry 4.0 and its impact on engineering. They highlight that this technology has experienced significant growth in publications and advances, establishing itself as a key element for innovation and competitiveness. They show the fundamental areas of research, the leading countries and future trends in the field. The study highlights the need to strengthen international collaboration and investment in research to maximize the benefits of additive manufacturing.

The article provides a comprehensive overview of the status and prospects of this technology in modern engineering.

This document, article, conducts a bibliometric analysis of research in additive manufacturing design over the last decade, highlighting trends, emerging areas, and key contributions in the field between 2014 and 2024. It provides a comprehensive overview of the growth and evolution of this discipline during the period analyzed [Celik et al., 2025].

[Amaya-Rivas et al., 2024] presents an overview of future trends in additive manufacturing for medical applications, highlighting its potential to revolutionize innovation in healthcare. It analyses technological advances and the challenges facing their effective clinical implementation.

Bibliometrics in engineering allows for the quantitative analysis of research trends and patterns in areas such as smart agri-food systems, as reflected in the article by [Manta, 2026]. This study examines the transformation of sustainability narratives towards digital infrastructures, highlighting the importance of scientific production in the advancement of sustainable technologies. The application of bibliometric techniques facilitates the identification of the main publications, authors and emerging topics in this field, which is essential for guiding future research and policies. It allows for the evaluation of the impact and evolution of knowledge in the integration of digitalisation in agriculture and food. Therefore, bibliometrics is a key tool for understanding how engineering drives innovation in smart agri-food systems.

[Herrera & Coronado, 2024] conduct a bibliometric analysis of complexity in manufacturing systems and its relationship with Industry 4.0. They examine trends, key areas of research, and the most influential authors in this multidisciplinary field. They highlight the importance of understanding complexity to optimize the adoption of advanced technologies in modern manufacturing. This study provides a comprehensive overview to guide future research in the field of Industry 4.0 and knowledge management.

The document by [Dehghan et al., 2025] conducts a bibliometric analysis on the integration of additive manufacturing in the contexts of Industry 4.0 and 5.0. They identify emerging trends, opportunities, and challenges associated with this technology, highlighting its potential to transform production processes and improve customization and efficiency. There is growing international collaboration and an increase in scientific output in this field. The study also highlights the need to address issues related to sustainability, quality and technological compatibility for successful implementation. His analysis provides a comprehensive overview of the current state and future directions of additive manufacturing in these industries.

The article by [Obi et al., 2022] conducts a bibliometric analysis of research into design for additive manufacturing, identifying areas of greatest interest in the field. Noteworthy is the sustained growth in publications and international collaboration, reflecting the importance of this technology in innovation. Provides a comprehensive overview of the most relevant authors, institutions and topics in the field.

Conduct a bibliometric analysis of additive manufacturing and its evolution in the production of goods. It highlights growth in research and the main trends in this area, identifying the most influential journals, countries, and authors [Dzogbewu et al., 2022]. They present an overview of the most relevant subject areas and future directions in additive manufacturing. The review provides a basis for understanding the current state and potential development of the sector. The study contributes to guiding research and applications in the field of additive manufacturing.

Bibliometrics is a fundamental tool in research, as it allows for the systematic analysis of trends, advances, and priority areas in a specific field, such as nanotechnology in chemical engineering. The article by [Nandiyanto et al., 2025] highlights its use in identifying emerging lines of research, evaluating scientific output, and guiding future lines of study. Bibliometrics facilitates understanding of the impact of publications and collaboration between researchers, thereby enriching the research process. This methodology is essential for optimising resources, defining research strategies and strengthening academic training in innovative areas.

From an engineering perspective, in a literature review on biotechnology and additive manufacturing, the most relevant variables include the properties of the materials used, such as biocompatibility, mechanical strength and biodegradability, as well as process parameters such as temperature, build speed and dimensional accuracy. It is crucial to consider characterization and internal structure analysis techniques to assess the quality and functionality of manufactured products, as well as the environmental impact and sustainability of processes. The integration of digital technologies, such as simulation and 3D modelling, also plays a key role in optimizing design and manufacturing. Interdisciplinary collaboration and innovation in biotechnology and advanced materials are crucial to advancing towards more efficient and personalized applications in the future.

In the literature review, other key parameters include process scalability, production speed, and associated cost, which are essential for commercial viability. International regulations and standards also influence the adoption of new technologies, along with ethical issues related to biotechnology. Real-time monitoring and quality control using sensors and automatic systems are emerging as critical variables for ensuring the reproducibility and safety of end products.

The following section will identify the methodology to be followed for the development of the bibliometric evaluation of the intersection of biotechnology with additive manufacturing.

Methodology

For the methodology, a comprehensive review of the literature will be conducted using specialized academic databases, selecting relevant publications in biotechnology and manufacturing. Inclusion and exclusion criteria will be applied to identify the most influential and recent research in the field. Bibliometric analysis techniques, such as citation analysis, keyword co-occurrence and network mapping, will be used to assess trends and relationships between the topics addressed. For this analysis, only the years 2024, 2025 and 2026 have been considered.

The article will focus on compiling and analyzing bibliographic data from publications indexed in databases such as Scopus, Web of Science and Google Scholar. Articles will be categorized according to their technological approaches, material properties and sustainability aspects. Subsequently, graphical visualizations of the interconnections between the most relevant variables will be produced, and the authors, journals and countries with the highest output and impact at this intersection will be identified. Emerging trends and probable future lines of research in this multidisciplinary area will be discussed.

The key findings of the bibliometric analysis will be summarized, highlighting the areas with the greatest development and the existing challenges. Recommendations will be proposed to promote interdisciplinary collaboration and technological innovation, with an emphasis on sustainability and regulation. This study aims to provide a comprehensive overview of the current state and future opportunities in the convergence between biotechnology and manufacturing.

Figure 1 presents a diagram illustrating the different stages to be followed in bibliometric evaluation. This framework is flexible and can be applied to different case studies, without being limited solely to biotechnology or additive manufacturing. Each phase of the process is designed to facilitate a comprehensive analysis of relevant scientific information, allowing trends, relationships and advances in the area under investigation to be identified. The structure of the diagram provides a clear and systematic guide that can be adapted to various disciplines and research topics. This ensures a robust and versatile methodology that optimizes the interpretation of bibliometric data. Diagrams are useful tools for conducting accurate and detailed assessments in any scientific field.

Box 1

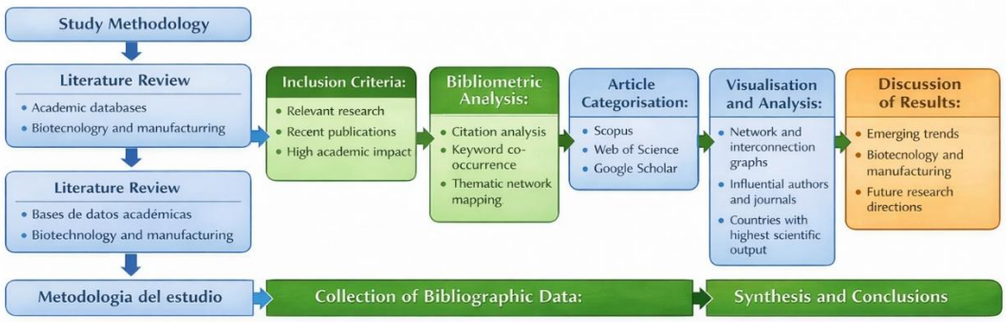


Figure 1

Methodology for bibliometric evaluation

Source: Authors

Each of the stages identified in Figure 1 represents the systematic methodology, focused on the convergence between biotechnology and manufacturing, showing in an orderly manner the key stages of the research and analysis process. In a logical and structured sequence, the outline begins with a comprehensive review of the literature in specialized academic databases and the application of inclusion and exclusion criteria to ensure the quality of the selected studies. Subsequently, bibliometric analysis is incorporated, which allows patterns, thematic relationships and trends to be identified by studying citations, keywords and research networks It also includes the compilation and categorization of articles according to technological approaches, material properties and sustainability aspects.

The diagram integrates the visualization and discussion of results, highlighting the most influential authors, journals and countries in the field. The process concludes with a summary of findings and conclusions aimed at identifying challenges, opportunities, and future lines of research that strengthen innovation and interdisciplinary collaboration. Table 1 details the main variables used in the methodology for bibliometric analysis. These variables enable us to understand the most important and relevant aspects of the study, facilitating a clear interpretation of the data. They provide a structured framework for evaluating production and influence on the subject matter addressed, contributing to a comprehensive understanding of the analysis performed.

Box 2

Table 1

Variables and indicators used in bibliometric analysis methodology.

Key variable	Parameters/Indicators	Purpose
Sources of information	Academic databases (Scopus, Web of Science, Google Scholar)	Ensure comprehensive and reliable coverage of scientific knowledge
Inclusion criteria	Thematic relevance, topicality, academic impact	Identify relevant, high-quality research
Exclusion criteria	Duplication, obsolescence, low number of citations	Refine the set of documents analyzed
Scientific output	Number of publications per year, authors and countries	Assess the growth and evolution of the study area
Academic impact	Number of citations, h-index, journal impact factor	Measuring the scientific influence of authors and sources
Thematic relations	Keyword co-occurrence, thematic clusters	Identify trends and links between lines of research
Bibliographic metadata	Authors, year, journal, affiliation, keywords	Structure the database for analysis
Technological approach	Type of technology, process or application	Classify studies according to their technical focus
Properties of materials	Physical, chemical or functional characteristics	Analyze the material impact on manufacturing
Sustainability	Environmental aspects, energy efficiency, regulation	Assessing the sustainable approach to research
Collaborative networks	Maps of authors, institutions, and countries	Identify key actors and patterns of cooperation
Emerging trends	New technologies, research gaps	Propose future lines of research

Source: Authors

Table 1 summarizes the essential variables and parameters for the bibliometric evaluation applied in this study, concisely integrating the main methodological phases of the analysis. The academic sources, selection criteria, and impact and scientific structure indicators used to examine research output are highlighted. Bibliographic metadata and thematic categorization are considered key elements for identifying interrelationships and trends. The table provides a clear and reproducible methodological framework for analyzing the literature at the intersection between biotechnology and manufacturing.

Results

Bibliometric evaluation is conducted using the VOSviewer tool, which allows for the analysis and visualization of networks of relationships between publications. In this process, a search was conducted using keywords related to the topic, employing co-occurrences to identify terms that appear together in the articles. Research focused on the article entitled 'Bibliometric evaluation of the intersection between biotechnology and additive manufacturing,' with the aim of collecting the main words and concepts associated with it. Based on the data obtained, VOSviewer will generate co-occurrence maps that will facilitate the visualization of relationships between different terms and authors in the field of study. This analysis will enable us to understand the trends, knowledge hubs and relevant connections in this interdisciplinary field. This can be seen in Figure 2.

Box 3

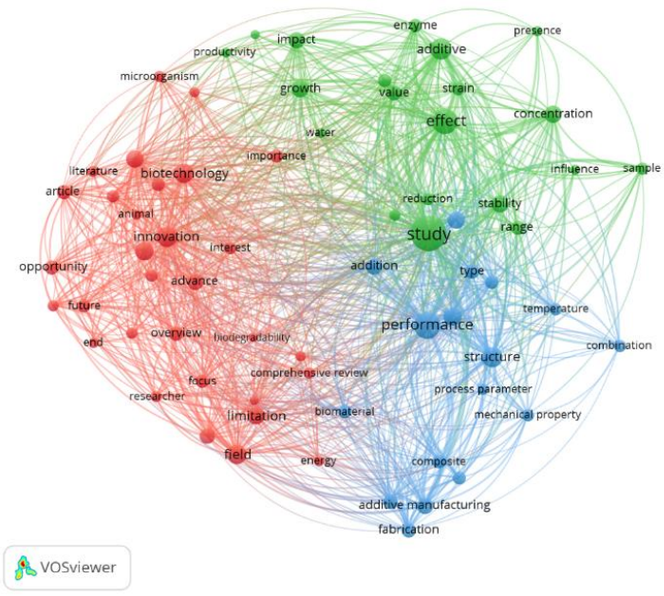


Figure 2

Bibliometric map with keywords

Source: VOSviewer

The bibliometric map shown in Figure 2 identifies the conceptual structure and thematic relationships of the analyzed literature, revealing the existence of three main interconnected clusters. The red cluster is associated with general approaches to biotechnology, innovation, and scientific review, reflecting conceptual discussions, future trends, and opportunities in the field. The green cluster focuses on biological and experimental aspects, such as enzymes, microorganisms, concentration and effects, indicating an emphasis on biochemical and process variables. For its part, the blue cluster groups together terms related to performance, structure, mechanical properties and additive manufacturing, highlighting technological application and materials analysis. The high density of links between clusters suggests strong multidisciplinary interrelationships, confirming that convergence between biotechnology and manufacturing is articulated both from biological fundamentals and from process performance and optimization. One more iteration in VOSviewer allows you to analyze relationships and trends in relevant literature. To this end, a search focused on authors was conducted to identify significant connections and collaborations on the subject.

The selection of data focused on articles related to the bibliometric evaluation of the intersection between biotechnology and additive manufacturing, specifically the article entitled “Bibliometric evaluation of the intersection between biotechnology and additive manufacturing.” This analysis will provide a comprehensive overview of the field, highlighting the most influential authors and collaborative networks in the subject area.

Box 4

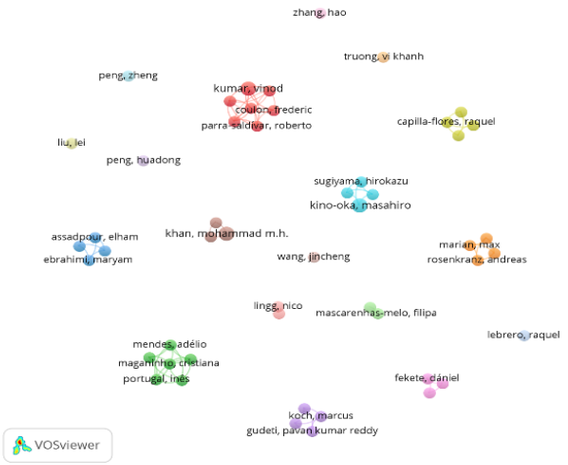


Figure 3

Bibliometric map by authors and co-authors

Source: VOSviewer

Figure 3 shows the collaboration between authors contributing to the field of study, revealing a fragmented network composed of multiple small clusters. Each group represents research teams with strong internal links but limited connections between clusters, suggesting mostly localized or thematically specific collaborations. Some central nodes stand out for proximity to other authors within their group, indicating a significant role in scientific output. The spatial dispersion of clusters reflects the geographical and institutional diversity of researchers. The map suggests a developing field, with clear opportunities to strengthen international and interdisciplinary collaboration. As a result, the graphs shown in Figure 4 and Figure 5 are presented, which are directly related to the bibliometric maps previously analyzed. These visual representations allow for a better understanding of the patterns and trends identified in the study.

Box 5

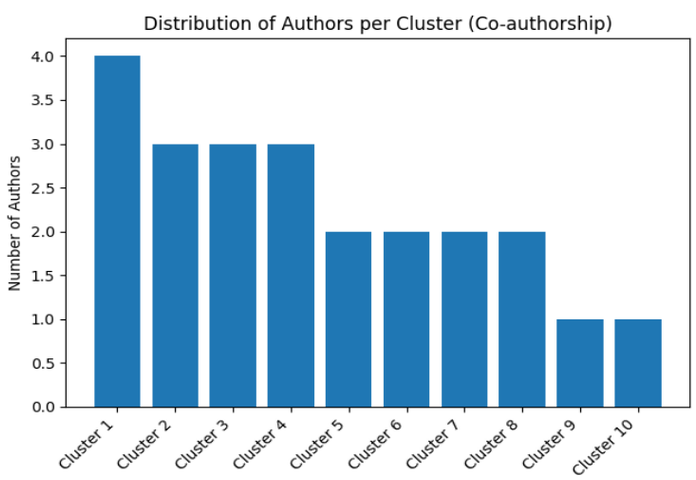


Figure 4

Distribution of authors.

Source: Authors

The graph in Figure 4, showing the distribution of authors by cluster, reveals a fragmented structure dominated by multiple small clusters with between two and four authors, and some isolated nodes. This pattern suggests a low density of global collaboration, where researchers work mainly in small teams with strong internal links. The absence of dominant clusters indicates that the field is not yet centralized around large consortia or single leaders. From a statistical perspective, the network shows high dispersion and a low average degree, which is characteristic of emerging or highly specialized areas. These results lead to clear opportunities for strengthening inter-institutional and international cooperation.

Box 6

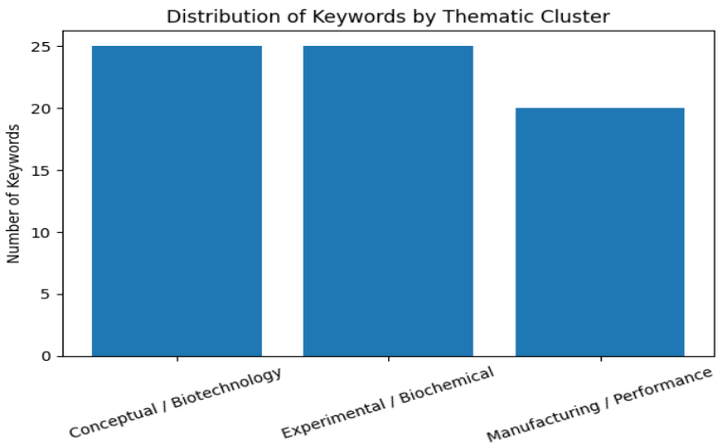


Figure 5

Distribution of keywords

Source: Authors

The distribution graph, Figure 5, of keywords by thematic cluster shows a balanced concentration in three major areas: conceptual/biotechnological, experimental/biochemical, and manufacturing/performance. The first two clusters have a slightly higher frequency, indicating a greater emphasis on theoretical foundations and experimental variables. The cluster associated with manufacturing and performance, although slightly smaller, maintains a significant presence, reflecting the applied orientation of the field. Statistically, this distribution suggests a balanced thematic structure, with high connectivity between clusters and strong interdisciplinarity. The analysis confirms that the research consistently integrates biological concepts, experimental evaluation, and technological performance.

Discussion

The results presented in [Rehman et al., 2023] highlight the crucial role of additive manufacturing in biomedical applications, demonstrating its ability to reduce energy consumption and facilitate rapid production during the COVID-19 pandemic. The classification of technologies and their energy efficiency highlight the versatility and sustainability of these processes in the field of health. It emphasizes how the adoption of these technologies has contributed to responding efficiently to emerging demands in times of health crises. The findings reinforce the potential of additive manufacturing as an innovative and sustainable tool for improving biomedical services.

[Caviggioli & Ughetto, 2019] reflect significant growth in research on the impact of additive manufacturing on industry, business and society, especially in the last decade. Geographical and thematic distribution shows a trend towards multidisciplinary approaches, highlighting the importance of integrating knowledge from different fields to understand their implications. It is noted that publications focus on theoretical studies and industrial applications; however, there is still room to explore social and economic aspects in greater depth. On the other hand, they highlight the importance of continuing to promote research that comprehensively addresses the effects of additive manufacturing. The results highlight the crucial role of this technology in transforming the productive and social environment, encouraging future lines of research.

The use of bibliometrics in conjunction with the findings of the article by [Liu et al., 2026] allows for more accurate identification of emerging trends and areas of focus in textile technology research. This approach facilitates the visualisation of collaboration networks, leading authors and institutions, as well as the evolution of priority topics in the field. By complementing the qualitative findings of the study, bibliometrics provides a quantitative view that supports strategic decisions in research and development. These methods enrich the understanding of the current landscape and future directions of innovation in textiles. This confirms the development of this research related to biotechnology and additive manufacturing.

For [Nain & Samal, 2025], there is evidence of growing collaboration between artificial intelligence and additive manufacturing, reflected in the increase in publications and the internationalization of research in this field. This indicates a clear trend towards the integration of both technologies to boost innovation and quality in the industry. It also highlights the need to strengthen cooperation between countries and disciplines to maximize the benefits of this technological convergence.

In some documents, such as [Ante, 2021], which indicates and reveals a trend in research on digital twin technology, highlighting its importance in the evolution of smart manufacturing and Industry 4.0. Bibliometric analysis shows an increase in publications and international collaboration, reflecting the interest and consolidation of the field. Identifying the main subject areas and influential authors, which helps to understand the structure of knowledge in this field. These contribute to defining future lines of research and strengthening the development of digital technologies in industry. The central role of digital twins in industrial digital transformation is noteworthy.

The impact of additive manufacturing on academic research is observed, as evidenced by bibliometric analysis and meta-analysis [Rodríguez-Martín et al., 2023]. Identifying key areas and patterns of development that enable a better understanding of future directions in this field. These studies provide a comprehensive overview that facilitates decision-making and guides future research in additive manufacturing.

[Abisuga & de Beer, 2023] report a significant increase in academic output on the opportunities offered by additive manufacturing in the creative industries, with the United States and China standing out as the main players in research. Bibliometric analysis shows a trend towards interdisciplinarity and diversification of applications, reflecting the transformative potential of this technology in fields such as art, design and fashion. The emergence of specialized journals and international collaboration underscore the importance of global cooperation for the advancement of the field. They suggest that, although challenges related to integration and regulation still exist, additive manufacturing continues to establish itself as an innovative tool with a significant impact on creative industries, promoting new forms of expression and production.

The results of [Gümüş, 2022] show a significant increase in the number of publications on Industry 4.0 in recent years, reflecting a growing interest in this topic. Making key research areas and institutions more productive, which highlights the concentration of academic efforts in certain countries and research centres. The distribution of authors and citations suggests an active and expanding community, with key contributions that have advanced the field. However, there is also a need for greater diversification in lines of research and international collaboration to strengthen knowledge development in this area. All of this provides a comprehensive overview of the current state and future trends in research on Industry 4.0.

[Wang et al., 2025] shows a contribution to research on 3D printing for osteochondral repair from 2010 to 2024, demonstrating growing interest in this area. The concentration of publications in certain regions and research centres highlights the importance of international collaboration in driving progress in this field. Emerging topics and leading journals indicate priority areas and future directions for research. These elements reflect the consolidated progress and potential of 3D printing, as well as the need to continue promoting innovation and academic cooperation.

[Laverde et al., 2020] shows that scientific output is related to biotechnology in the agricultural and agro-industrial sector, as identified by the increase in publications and the diversification of research areas. Observing a concentration of studies in certain regions and countries, indicating a priority interest in these geographical areas.

Analysis of collaborative networks reveals a trend towards international partnerships, strengthening the transfer of knowledge and technologies. This identifies challenges related to the unequal distribution of resources and the need for greater investment in research in less represented regions. They emphasize the importance of promoting global partnerships and policies that drive innovation in biotechnology for the sustainable development of the sector.

The article by [Lee et al., 2026] presents a mechanistic and bibliometric review of the use of bacteriophage-functionalised biopolymers in cold chain packaging in the poultry industry. The main findings highlight the potential of these solutions to improve food safety and extend the shelf life of meat products. It points out that biotechnology and additive manufacturing enable the development of smart and sustainable packaging that responds to current market demands. The research highlights advance in the integration of bacteriophages into biopolymeric materials, promoting innovative approaches to preservation and microbiological control. The study underscores the positive impact of these technologies on the food industry, driving safer and more efficient practices.

The production and dissemination of research on grafting techniques in commercially valuable plant species has been observed through the number of publications and international collaboration [Ortigoza-García et al., 2024]. The geographical distribution of authors shows a strong presence in countries with advanced agricultural development, indicating a priority interest in improving grafting practices to optimize production. Bibliometric analysis reveals that the most influential and cited journals in this field concentrate their output in publications specializing in agriculture and horticulture, suggesting a consolidation of knowledge in these areas. Co-citation and collaborative networks highlight the interconnection between institutions, emphasizing the importance of cooperation in advancing technological innovation. There is a possible gap in the representation of developing regions, which limits the dissemination of research in contexts with different agroclimatic conditions. Meanwhile, the findings reflect sustained growth in scientific output but also point to the need to broaden global participation to diversify and strengthen knowledge.

Conclusions

The bibliometric analysis conducted reflects sustained growth in scientific output in the emerging field combining biotechnology and additive manufacturing, showing a trend towards biomedical applications and other sectors, as observed in the research of other authors. The application of tools such as VOSviewer made it possible to identify the primary areas of interest, key actors and thematic relationships, confirming the multidisciplinary nature and international collaboration still under development. Co-occurrence maps and author networks show an expanding community, with opportunities to strengthen global cooperation and boost innovation at the intersection of these disciplines. The research also reveals that, although significant progress has been made, gaps remain in collaboration and diversification of regional contributions, limiting the scope of knowledge and its impact. The integration of variables such as material properties, sustainability, and technological approaches is essential for guiding future research and practical applications. In short, the field presents a promising outlook, with dynamic growth that requires coordinated efforts to consolidate lines of research and promote innovative and sustainable solutions in health, industry and the environment.

The analysis shows that the trend towards international collaboration and interdisciplinarity is becoming increasingly pronounced, highlighting a growing field with the potential to impact different sectors. The distribution of authors and keywords indicates a balanced thematic structure, fragmented, suggesting the need for greater integration and cooperation between researchers and regions. The identification of emerging trends, such as additive manufacturing in biotechnology and medical applications, points to key directions for future development. Visual analysis and network maps facilitated understanding of research dynamics, enabling the identification of priority areas and gaps in knowledge.

In this regard, strengthening international partnerships and promoting multidisciplinary approaches will be essential to enhancing innovation and sustainability in this booming field. Bibliometric evaluation is therefore a valuable tool for guiding strategic decisions in research and science policy.

The study confirms that interest in the convergence of biotechnology and additive manufacturing is booming, driven by technological advances and the need for innovative solutions in healthcare, industry and agriculture.

The trend towards greater collaboration and the integration of multidisciplinary approaches favours the creation of more robust and applicable knowledge. Challenges remain in relation to unequal regional participation and the need to establish international standards that facilitate technology transfer. Emerging areas, such as biomaterials and artificial organs, open new research opportunities that should be explored in greater depth. The use of bibliometric analysis allows us not only to visualize the current situation, but also to project future scenarios and define strategic lines of action. The field shows promising growth that requires coordinated efforts to consolidate its benefits and expand its global impact. The constant evolution of digital and biotechnological technologies will be key to transforming and enhancing applications in different areas, promoting sustainable and innovative development.

Future work in bibliometric evaluation between biotechnology and additive manufacturing should focus on developing specific metrics that reflect the particularities of each field, allowing for a more accurate and enriching comparison. It is essential to analyze emerging trends, patterns of international collaboration and key players to understand how these areas evolve both jointly and separately. The integration of multidisciplinary databases should be promoted to facilitate a holistic view of the impact and innovation in both disciplines.

Future research should explore the influence of emerging technologies and funding policies on the growth of these fields. Bibliometric evaluation can complement qualitative analyses, providing indicators that guide strategic decisions in research and development. This will enable the identification of opportunities for collaboration and areas of interest that promote scientific and technological advances in biotechnology and additive manufacturing.

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence in this chapter.

Author contribution

González-Sosa, Jesús Vicente: Contributed to the project idea, research method and technique.

Avila-Soler, Enrique: Contributed to the project idea, research method and technique.

Zavala-Osorio, Yadira: Contributed to the project idea, research method and technique.

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