US research and innovation performance

Outcomes and impact in critical and emerging technology areas

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This study was produced by Elsevier's Research Networks Team during May through November 2025. Principal contributors: **Dr. Nimmi Kannankutty**, VP Academic Relations (North America); **Prof. Carlos Henrique de Brito Cruz**, SVP Research Networks; **Dr. Peter Darroch**, Director, Segment Marketing; and **Anusha Natarajan**, Data Analyst.

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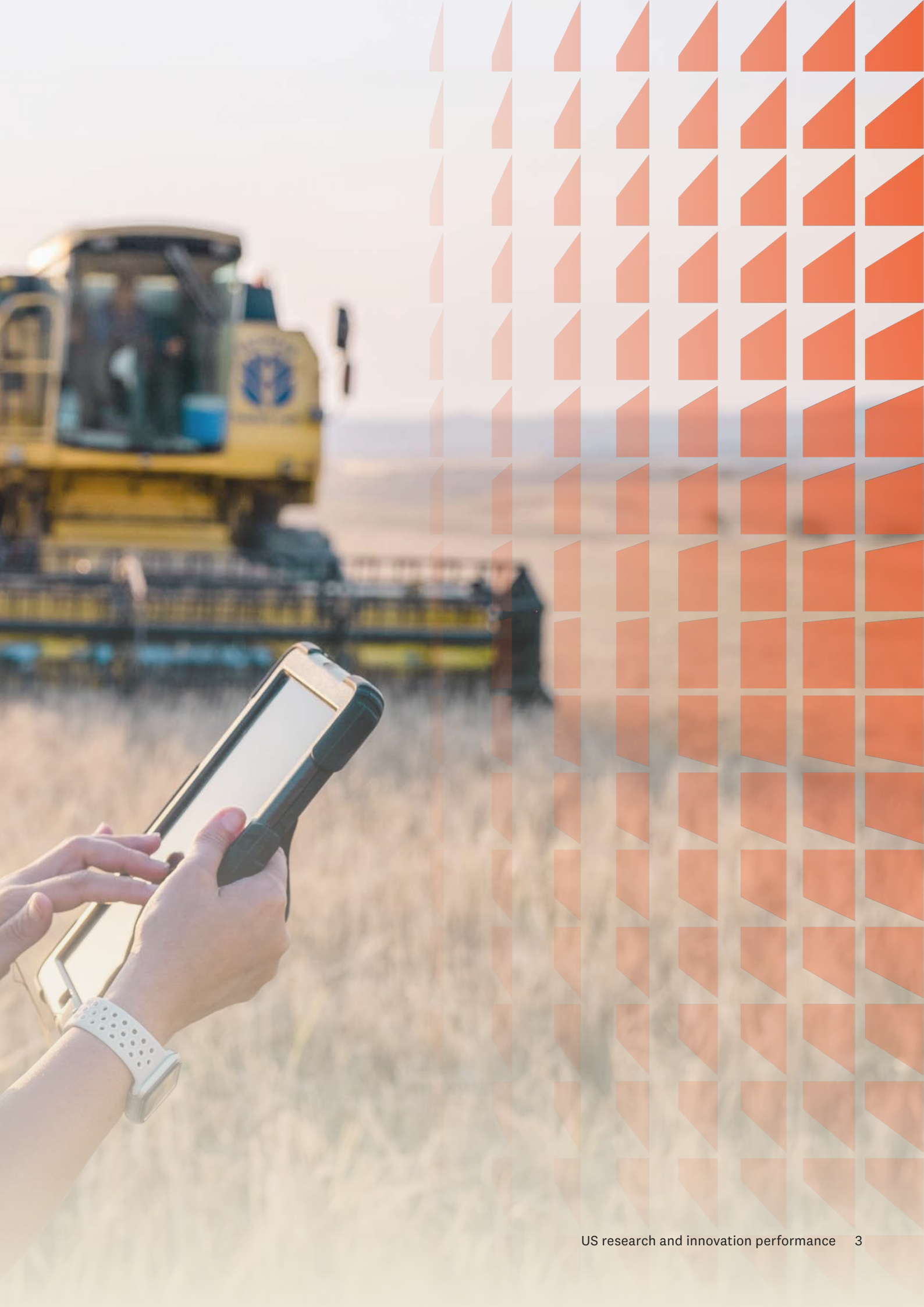


Contents

Explore the latest trends in US research excellence, highlighting data on high-quality outputs in five key critical and emerging technology areas: Artificial Intelligence, Quantum Information Science, Nuclear Technology, Semiconductors, and Biotechnology.

As a prominent player in the global research landscape, the US not only demonstrates disciplinary depth and breadth in its research output (as measured by publications) but also stands out for its impact on cross-disciplinary science and technology research in critical and emerging technology areas. Both academic and industry research outputs have high citation impact; these trends are further enhanced when the publications derive from industry-academic collaboration.

International competition is strong across these key areas of US investment, presenting both opportunities and challenges for US competitiveness. With notable strength in advancing new technologies, US research plays a vital role in shaping both national and global advancements. Here, we present key insights that highlight the US position as a leading hub for innovative research and collaborative efforts.

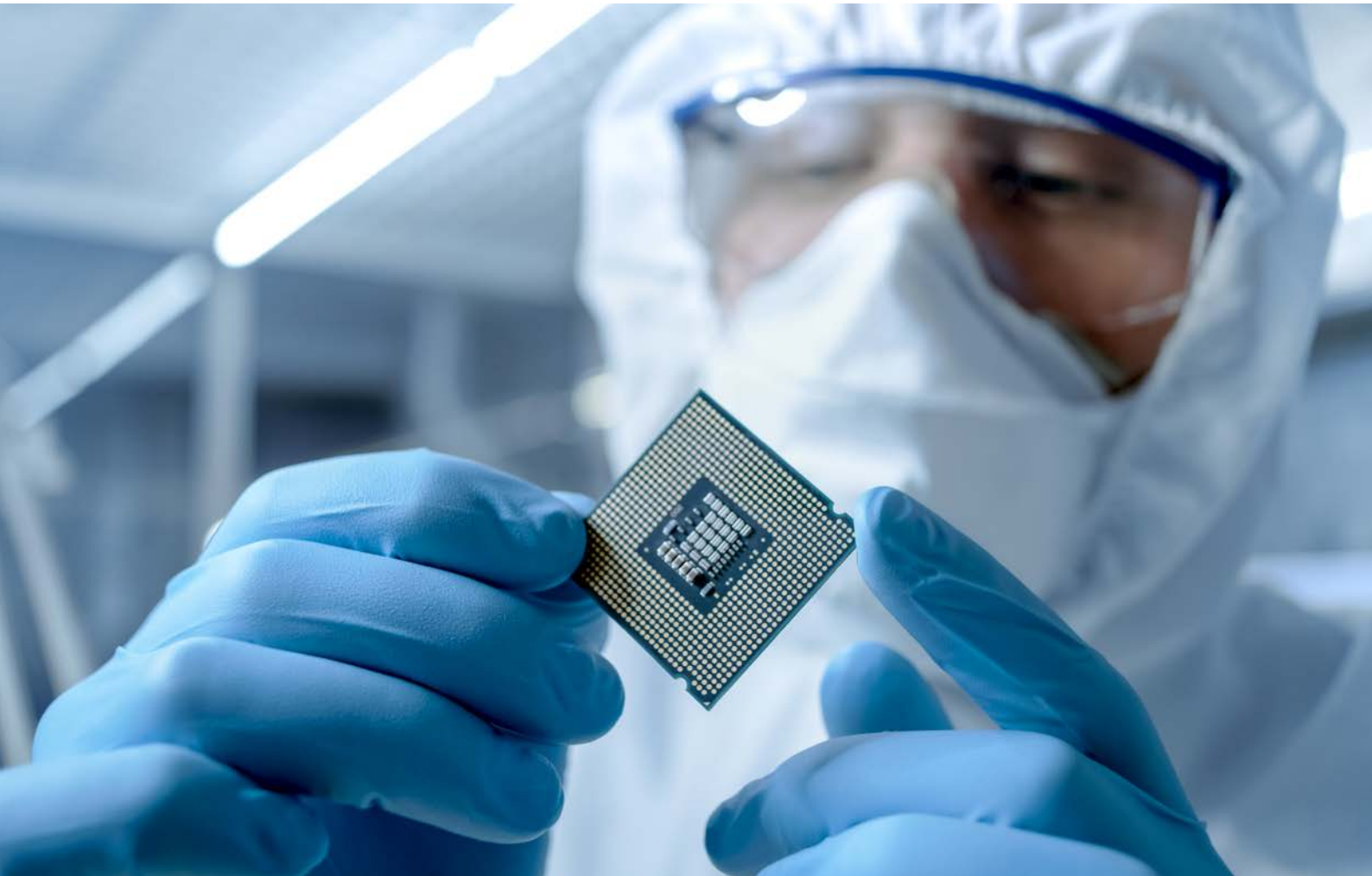
All data was sourced from Scopus and SciVal and refers to the period 2015 – 2024 unless otherwise stated.

To explore the analyses in more detail please visit the online version at:

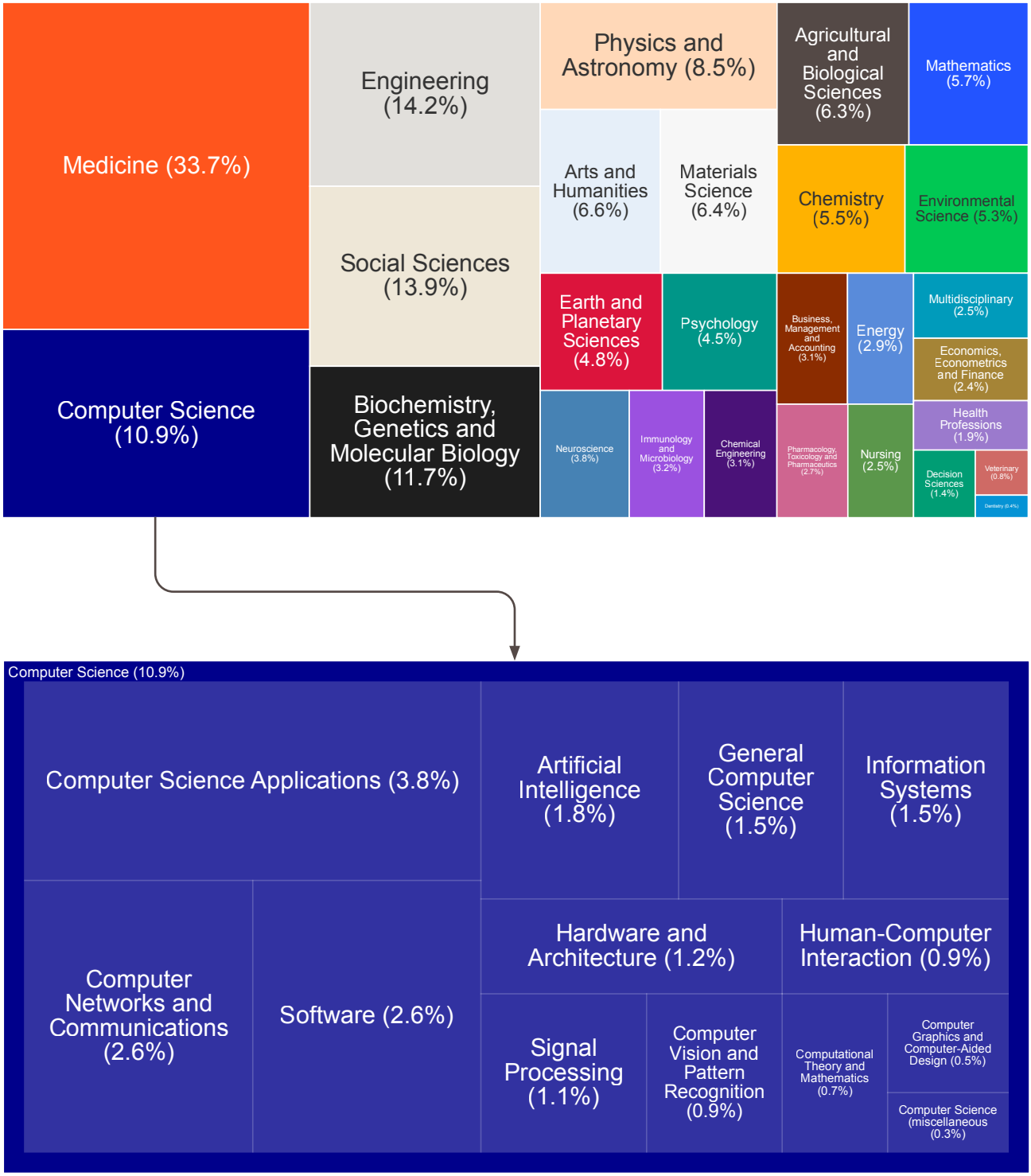
elsevier.shorthandstories.com/us-research-and-innovation-performance/index.html

Research and innovation in the US

Over the past ten years, US research output reached a total of 7,524,149 scholarly publications, representing over 20% of the global total. The depth and breadth of US research output spans all areas of science and technology, as well as arts and humanities fields. This profile also reflects the multidisciplinary nature of the publications, as many US publications cut across fields, and are therefore represented more than once in the distribution.



US publication profile



Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

Global R&D intensity and citation impact

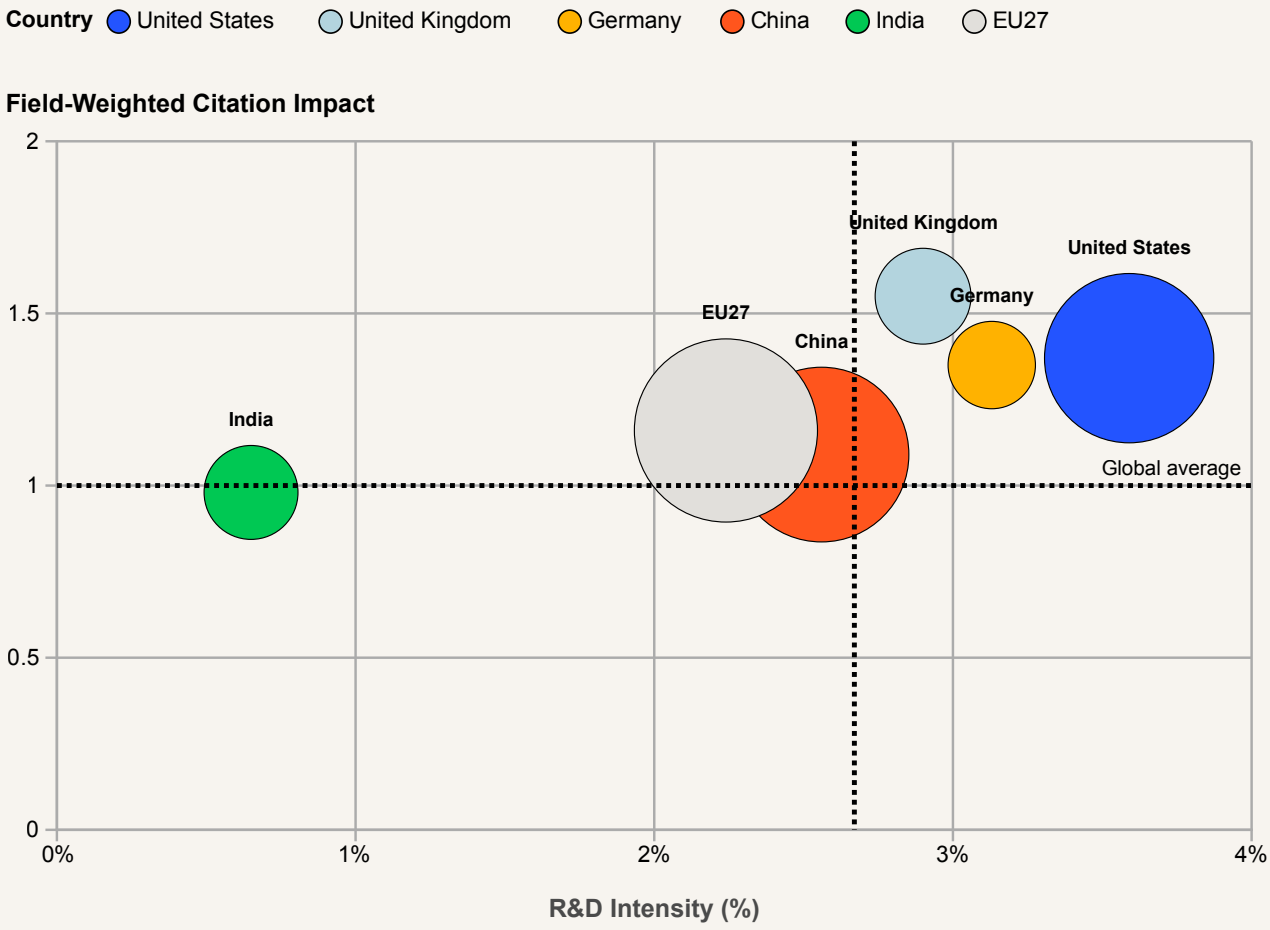
Research and development (R&D) investments enable science and technology innovation. The strong US performance in scholarly output across every discipline reflects robust US national R&D investments by all sectors.

The US leads in R&D intensity with R&D spending at 3.6% of GDP, outperforming Germany, UK, China, EU27 and India. R&D intensity is defined as the percentage of GDP that is spent on R&D.

US research is cited 37% more than global average, second only to the UK among the major economies analyzed. This is based on the Field-Weighted Citation Impact (FWCI) of US publications (which is 1.37). The UK has an FWCI of 1.55.

US R&D spending outperforms the countries/economies analyzed at 3.6% of GDP. The strong performance in scholarly output reflects robust research investments by all sectors.

Global R&D intensity and citation impact, by country/economy (2015-2024)



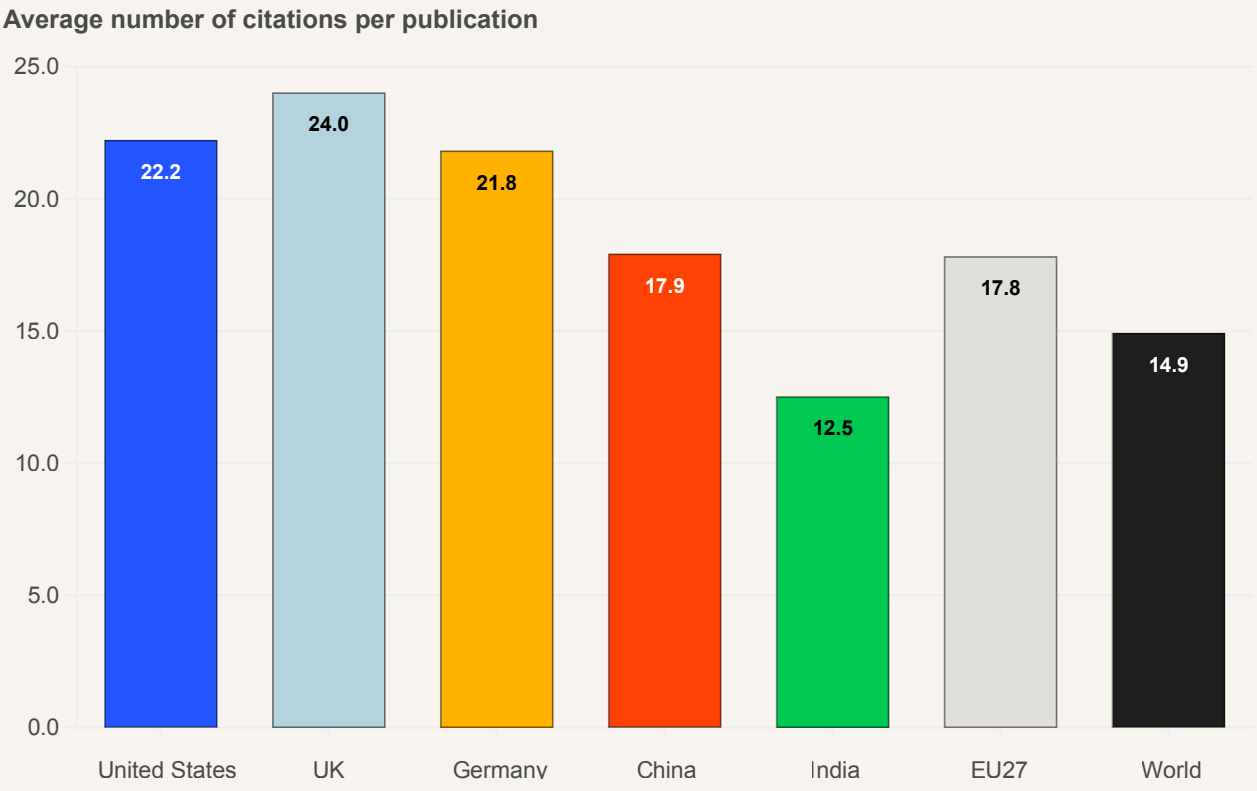
Source: Scopus and SciVal based on data extracted on 12th November 2025, R&D Intensity (data for 2022): https://data.worldbank.org/ indicator/GB.XPD.RSDV.GD.ZS
Credit: Elsevier

US publications are cited, on average, 22.2 times per publication

Citations per publication is one indicator of the importance of the underlying research.

US publications from the period 2015-2024 have received almost 167 million citations. The US average of 22.2 is well above the global mean of 14.9. Among the major economies analyzed, only the United Kingdom has a higher average citation rate (24.0).

Citations per Publication, by country/economy (2015-2024)



Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

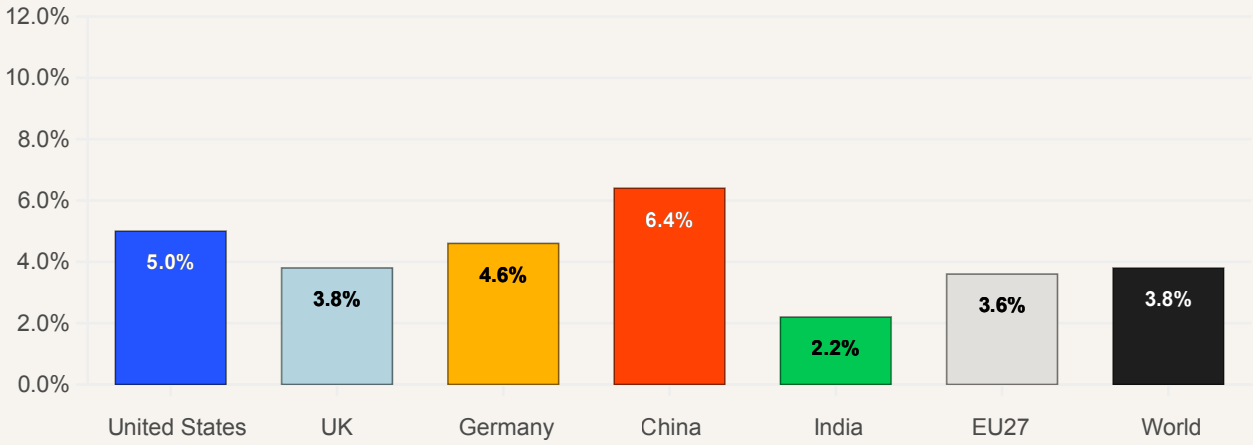
US publications are cited in patents and policy documents above the global average

While many citations are to other journal publications, research also contributes to innovation and commercialization and to the development of public policy. Citations of publications in patents or policy documents are another indication of the relevance and impact of research.

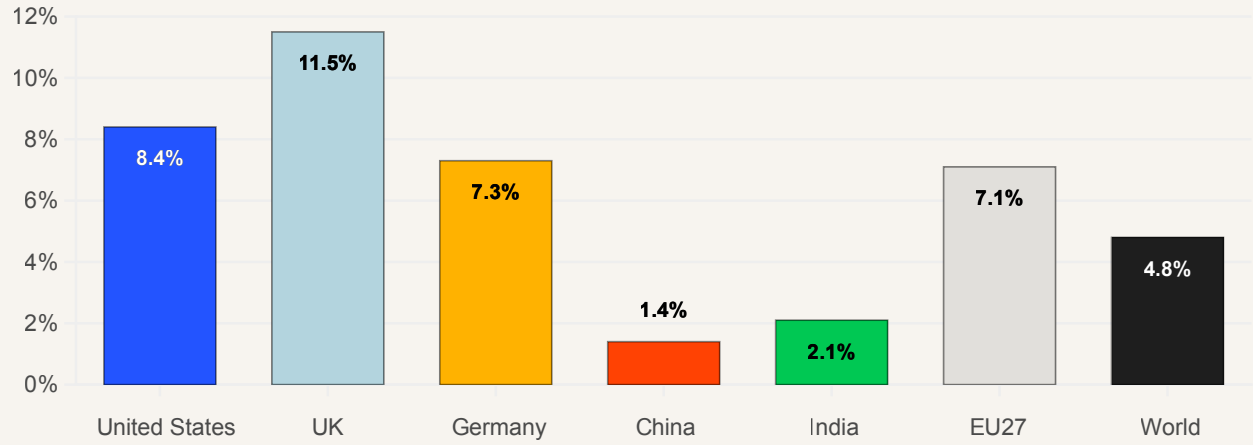
The share of US research publications cited in patents is 5.0%, which is above the global average of 3.8%. Only China outperforms the US at 6.4%.

The share of US research publications cited in policy documents is 8.4%, which is also above the global average of 4.8%. Only the UK outperforms the US, at 11.5%.

Share of publications cited in patents, by country/economy (2015-2024)



Share of publications cited in policy documents, by country/economy (2015-2024)



Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

Critical and emerging technology areas

The US federal government has prioritized research investments in five critical and emerging technology areas:

- Artificial Intelligence
- Biotechnology
- Nuclear Technology
- Quantum Information Science
- Semiconductors

Advances in each of these technology areas requires a multidisciplinary approach, and US scholarly output shows the contributions of each discipline to research advancement and innovation in each of the five areas. Critical and emerging technology areas change rapidly over time. The next few sections provide a snapshot of US performance in these five selected areas in the period 2015-2024.

Note: Publications can be assigned to multiple technology areas and so can be counted more than once.

Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

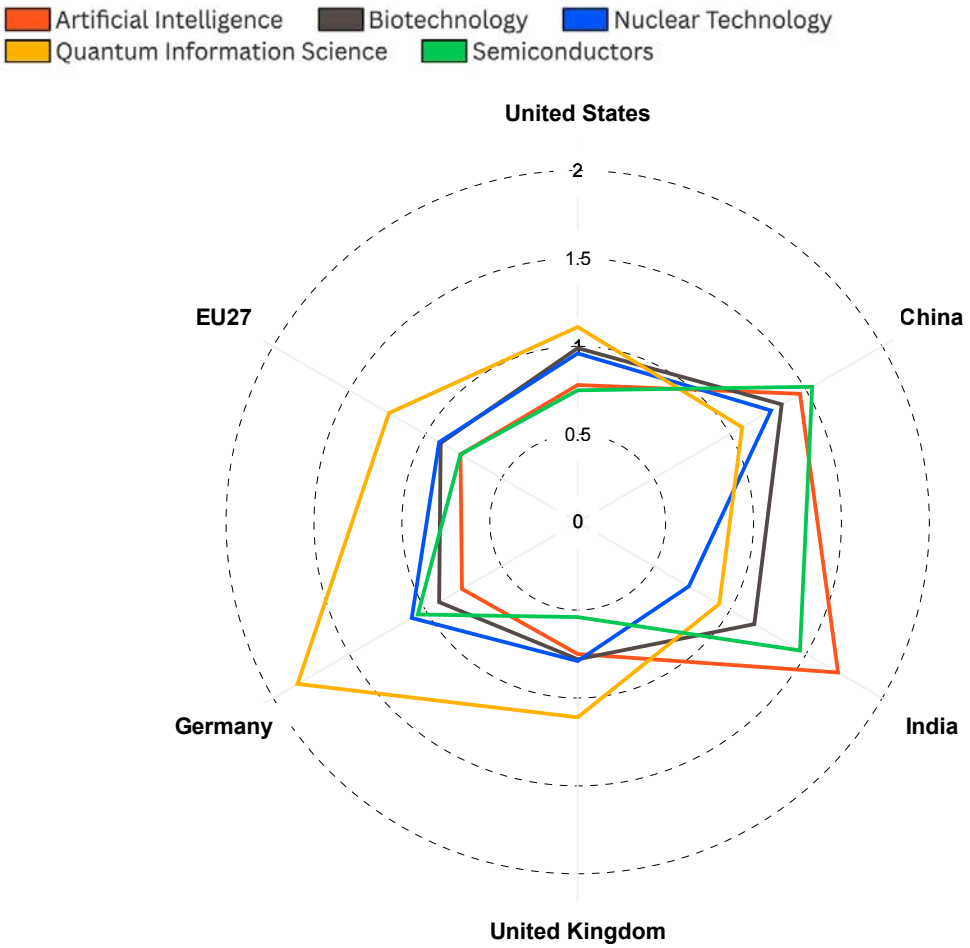
Global view of the five technology areas

This chart shows the Relative Activity Index (RAI) for selected countries/economies, indicating the relative share of each countries/economies output in each technology area, relative to the global activity in that technology area. A value of “1” corresponds to the global level of activity.

The US has a greater focus in the field of quantum information science compared to global activity in this field, similar to Germany, the UK, and the EU27. In all other technology areas, US and European activity is at or below the global level of activity. US activity is lowest in semiconductors, where the RAI is 0.75.

This pattern contrasts with China and India, where there is relatively higher level of activity in many of technology areas relative to the global level. Notable levels of RAI for India are in in artificial intelligence (1.71) and semiconductors (1.46); and China in semiconductors (1.54), artificial intelligence (1.46), biotechnology (1.34), and nuclear technology (1.27).

Relative Activity Index in the 5 technology areas, by discipline (2015-2024)



Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

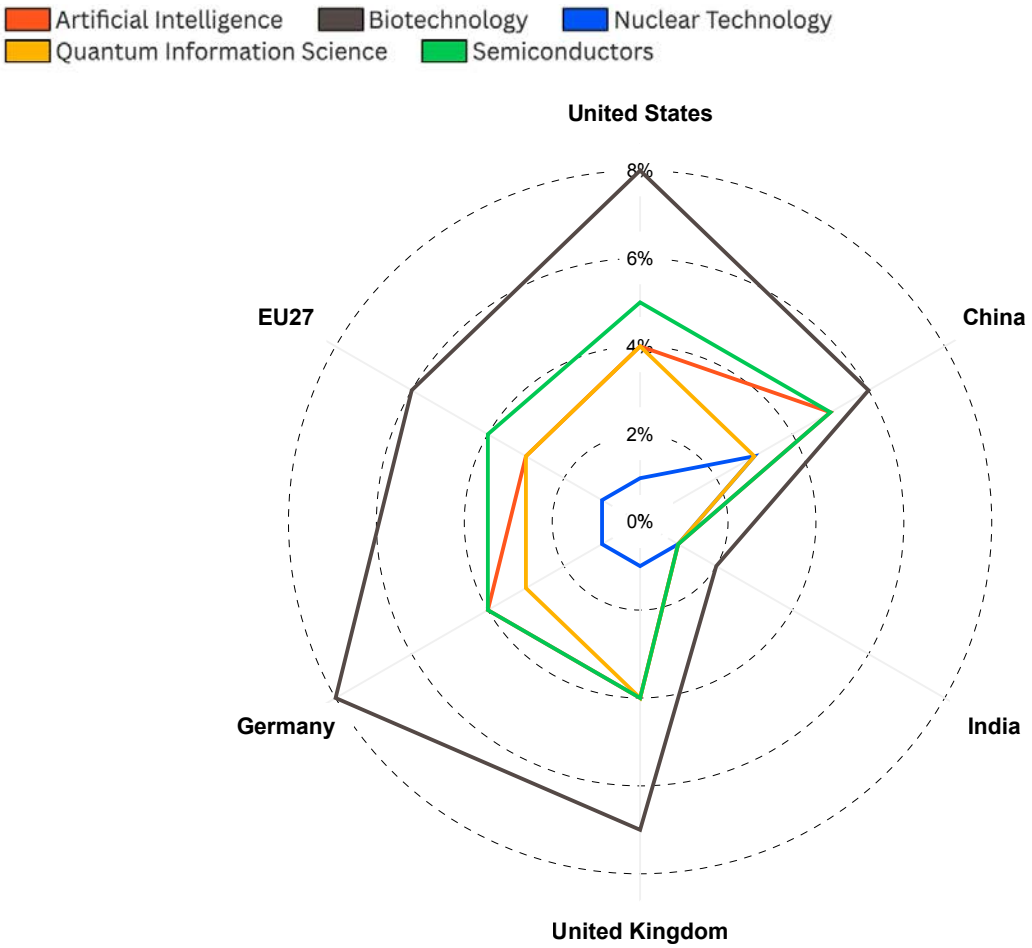
Research impact on innovation pathways

There is a strong interplay between research and technological innovation and commercialization across the five technology areas globally.

Some 8% of US publications in biotechnology are cited in patents. Except for India, all the selected countries/economies show a strong connection between publications and patent citations in this area.

The US has relatively high rates of patent citations across all the areas, except in nuclear technology, where only 1% of US publications are cited in patents. Europe and China show a more moderate share of publications being cited in patents across the five areas while China has a larger share of publications being cited in patents in nuclear technology (3% compared to 1% for all the other countries/economies).

Share of publications (%) cited in patents in the 5 technology areas (2020-2024)



Source: Scopus and SciVal based on data extracted on 21st May 2025.
Credit: Elsevier

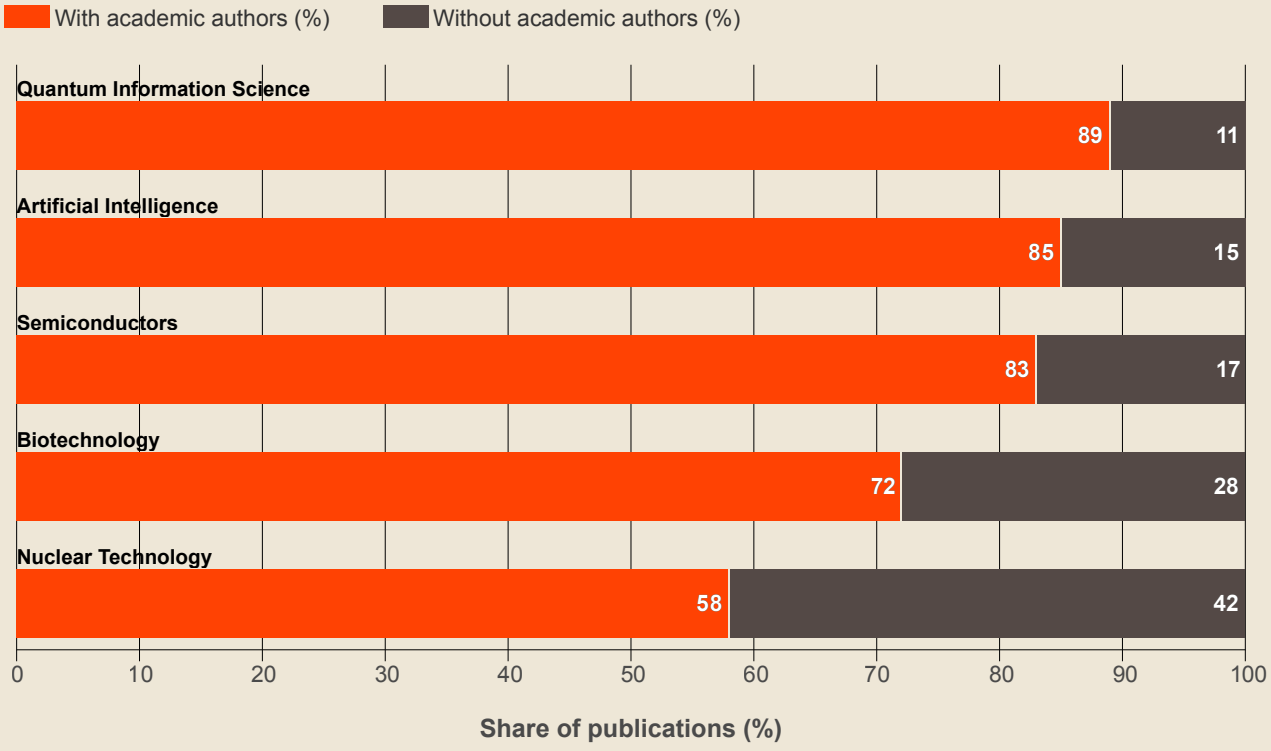
Academic contributions

Publications in each of the five technology areas involve authors from multiple sectors. However, it is notable that US academic contributions are critical to each technology area.

US academic researchers are authors of 58-89% of US publications across the five technology areas.

Their role is even more prominent in quantum information science, artificial intelligence, and semiconductors, where they are authors in more than 80% of the US publications in these areas.

Contribution of US academic authors to publications in the 5 technology areas (2015-2024)



Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

A majority of US publications in the five technology areas have academic authors.

Top US academic institutions with publications in nuclear technology (2015-2024)

A deeper dive into the academic contributors to scholarly output in nuclear technology shows how research contributions are dominated by public institutions, and institutions that are in proximity to nuclear facilities.

The table shows the top 10 US academic institutions contributing to the nuclear technology area. In addition to significant levels of research output, through the FWCI, we can also see that research outputs from 7 of these institutions in this area have been cited more than would be expected based on the global average for similar research outputs. Research outputs from MIT are cited over 50% more often than the global average. The total number of citations complements the FWCI view, indicating the magnitude of the influence these publications have on progressing knowledge and understanding in nuclear technology.

Top US academic contributors in nuclear technology (2015-2024)

Institution	Number of Publications	Field-Weighted Citation Impact (FWCI)	Citation Count
Massachusetts Institute of Technology	1,772	1.5	40,173
University of Tennessee System	1,136	1.14	21,031
University of Tennessee, Knoxville	1,117	1.16	21,487
University of Alabama in Huntsville	1,107	1.17	21,462
University of Michigan, Ann Arbor	1,044	1.19	21,397
North Carolina State University	887	0.86	9,261
University of Wisconsin-Madison	853	0.86	9,346
Texas A&M University	724	1.27	14,498
University of Rochester	687	0.8	9,072
Pennsylvania State University	613	1.58	15,148

Source: Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

Industry contributions

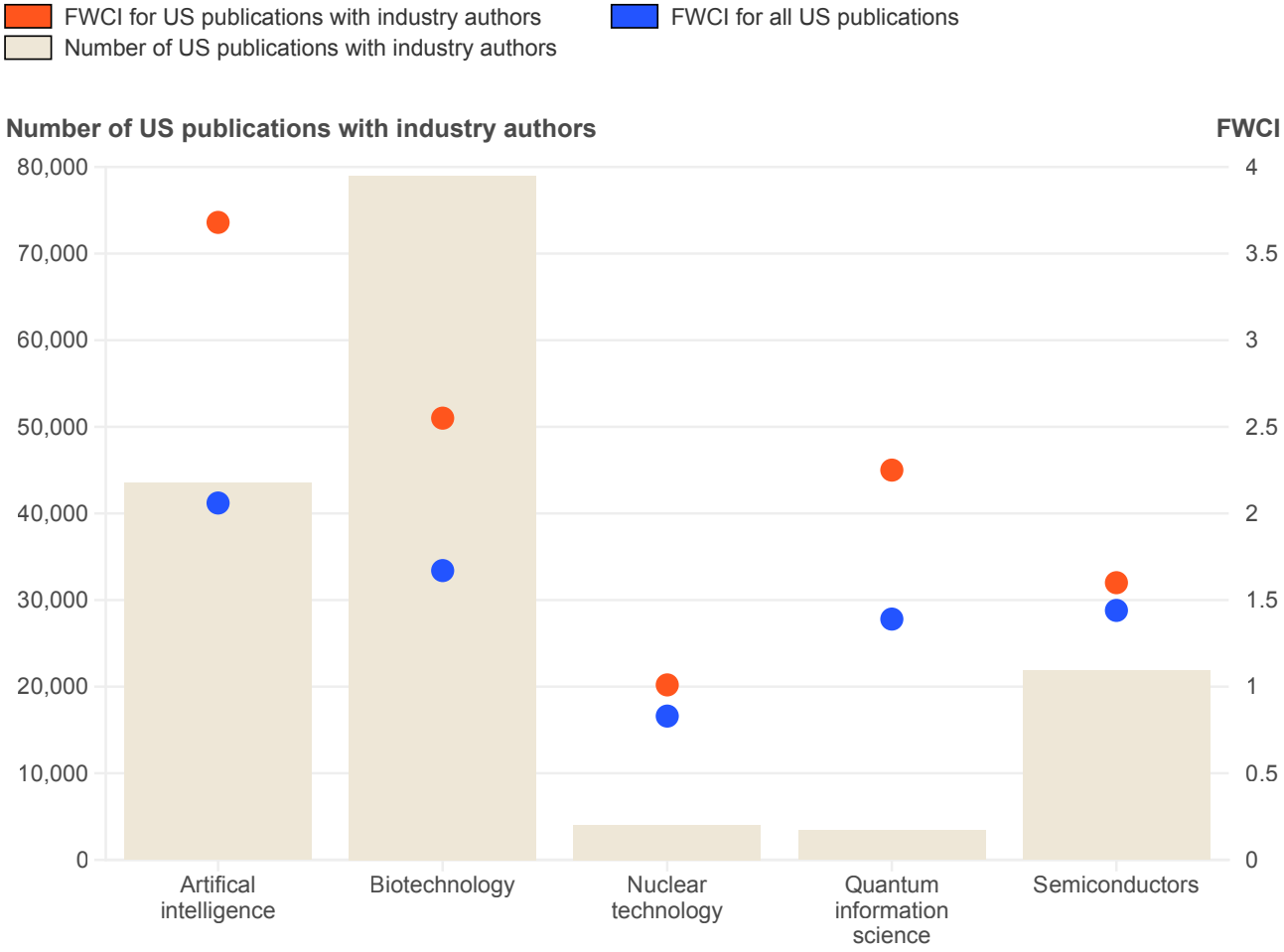
While the scale of research output from industry is smaller overall than that of academic institutions, industry-based research is essential to successful innovation and commercialization.

In every technology area, US publications with an industry author have higher citation impact as measured by FWCI than all US publications in each area. This is particularly notable in artificial intelligence, biotechnology, and quantum information science.

In artificial intelligence and biotechnology, US publications with an industry author are cited 100% more than all US publications when compared to the global average. The increase in citation impact is the smallest in semiconductors, where industry-authored US publications are cited only 16% more than all US publications in this area when compared to the global average.

Differences in the citation impact increases achieved through industry collaboration are likely driven by the maturity of research in each technology area and on the developmental phase of innovative and commercialization activities.

US industry contributions in the 5 technology areas (2015-2024)



Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

Top US Industry contributors in quantum information science

Within the emerging field of quantum information science (QIS), there is a large gap between the FWCI of all US publications (1.40, or 40% above the global average) and FWCI of industry-authored publications (2.25 or 125% above the global average). This indicates the impact of industry-authored publications in this area.

In this table, the top industry contributors to publications in quantum information science are shown. The FWCI of QIS publications by authors from these companies is mostly above 1.40. The total number of citations complements the FWCI view, indicating the magnitude of the influence these publications have on progressing knowledge and understanding in QIS.

Top US industry contributors in quantum information science (2015-2024)

Institution	Number of publications	Field-Weighted Citation Impact (FWCI)	Citation count
Alphabet Inc.	304	5.07	35,381
IBM	280	3.12	11,964
Microsoft USA	170	2.75	7,284
Intel	140	2.43	5,339
Raytheon	113	1.82	4,098
BBN Technologies	109	1.97	4359
Rigetti Computing	84	2.32	3,263
KBR, Inc	59	5.82	9,888
Northrop Grumman	59	1.21	1,367
HYPRES, Inc.	55	0.9	957

Source: Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

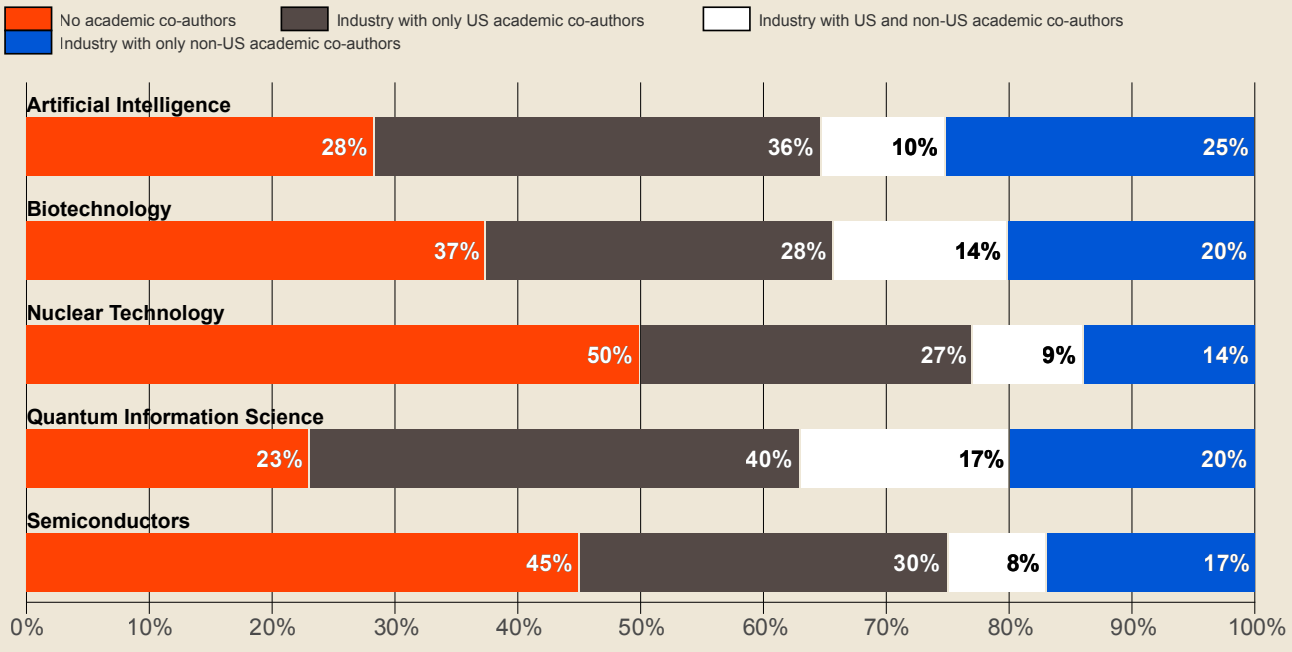
Industries collaborate intensely with universities. In each technology area, more than 50% of US publications with an industry author ALSO have an academic author.

Industry-Academic collaboration

Industry-academic collaboration is widespread in the five technology areas. Corporations in the US collaborate intensively with universities, both in the US and globally. This chart demonstrates the extent of that collaboration. Among US publications with an industry author, less than 50% in each technology area have only industry authors. The highest share of 'industry-only' papers is in nuclear technology (50%).

Industry publications are very likely to have an academic co-author. That collaboration is not only with US universities, but also with non-US universities. Between 8%-17% of industry publications in the five areas have both US and non-US co-authors. Publications in quantum information science have the highest rate of industry and academic co-authorship (77%).

Industry-Academic collaboration worldwide, by technology area (2015-2024)



Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

Industry-US Academic collaboration in the five technology areas

This figure demonstrates the effects of industry and US academic collaboration on citation impact.

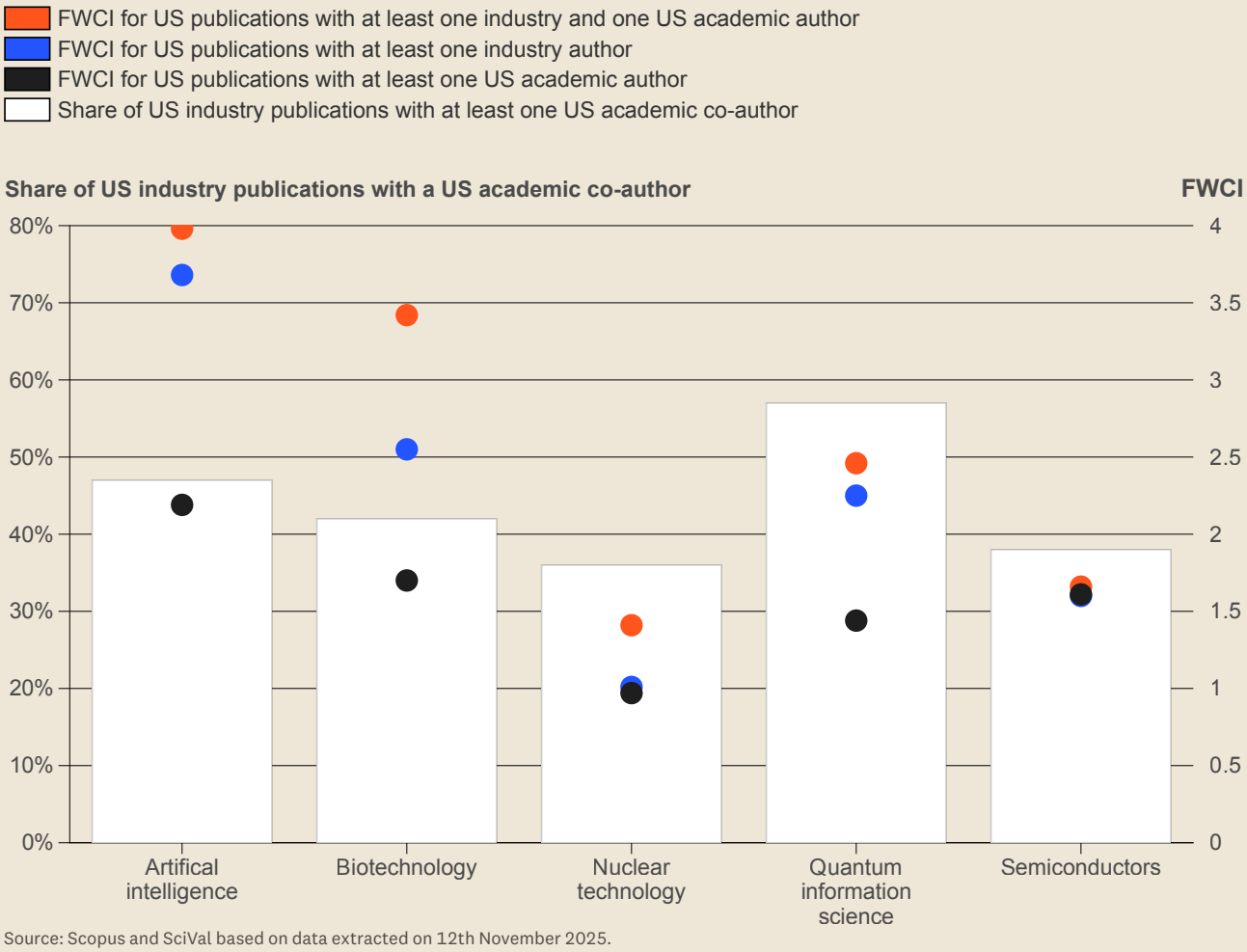
When industry collaborates with US academics, this collaboration consistently has higher FWCI than all industry publications, or all US academic publications. For example, in biotechnology:

- Publications with at least one US academic author have FWCI of 1.70
- Publications with at least one industry author have FWCI of 2.55
- Publications with at least one industry AND one US academic author have FWCI of 3.42

This highlights one of the many benefits and impacts of industry-US academic collaboration.

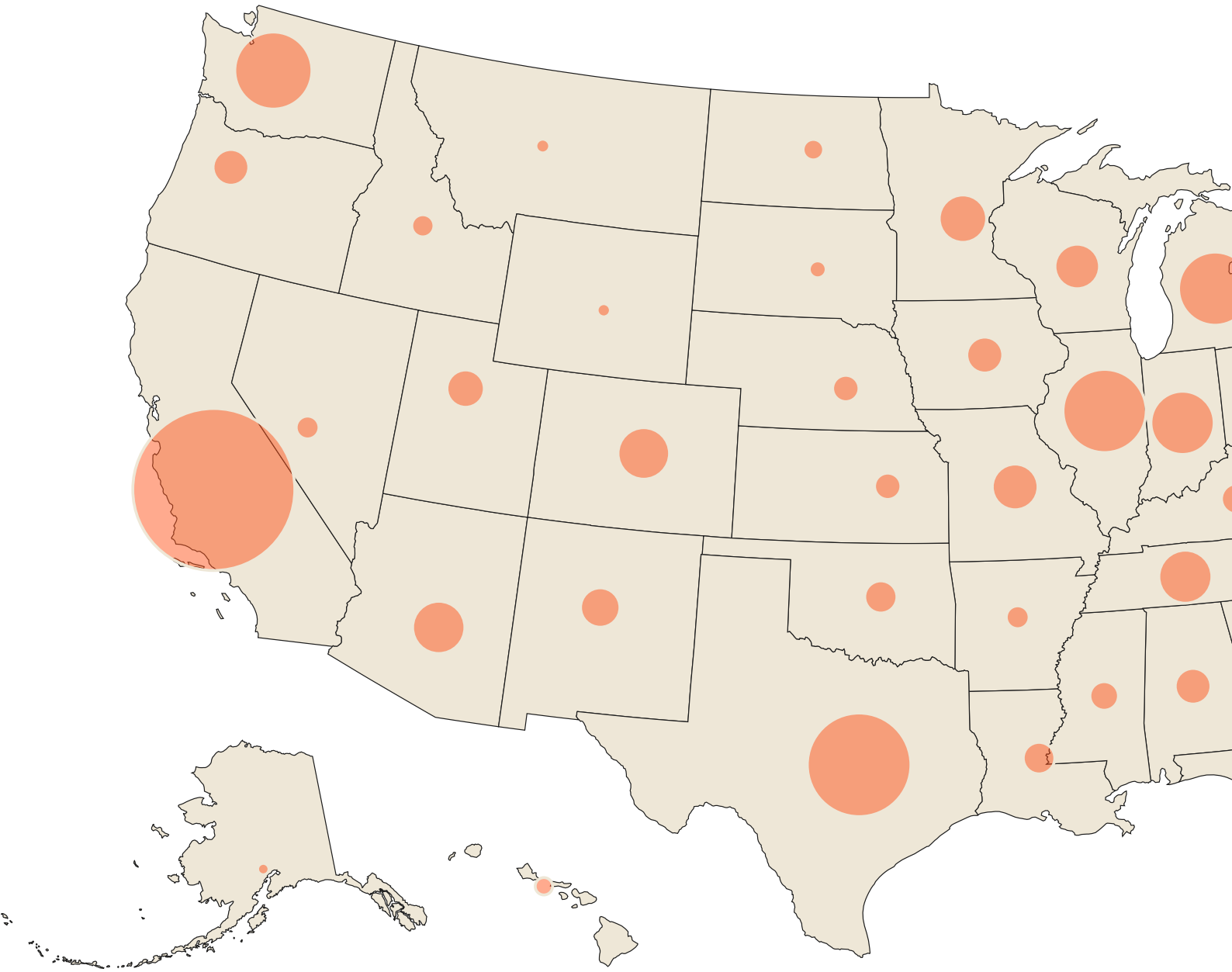
This effect is smallest in the semiconductors technology area where industry publications that also include a US academic co-author only have a slightly higher FWCI than publications with at least one industry author.

Share of US publications with academic co-authors and FWCI, by technology area (2015-2024)



Source: Scopus and SciVal based on data extracted on 12th November 2025.
Credit: Elsevier

Geographic distribution



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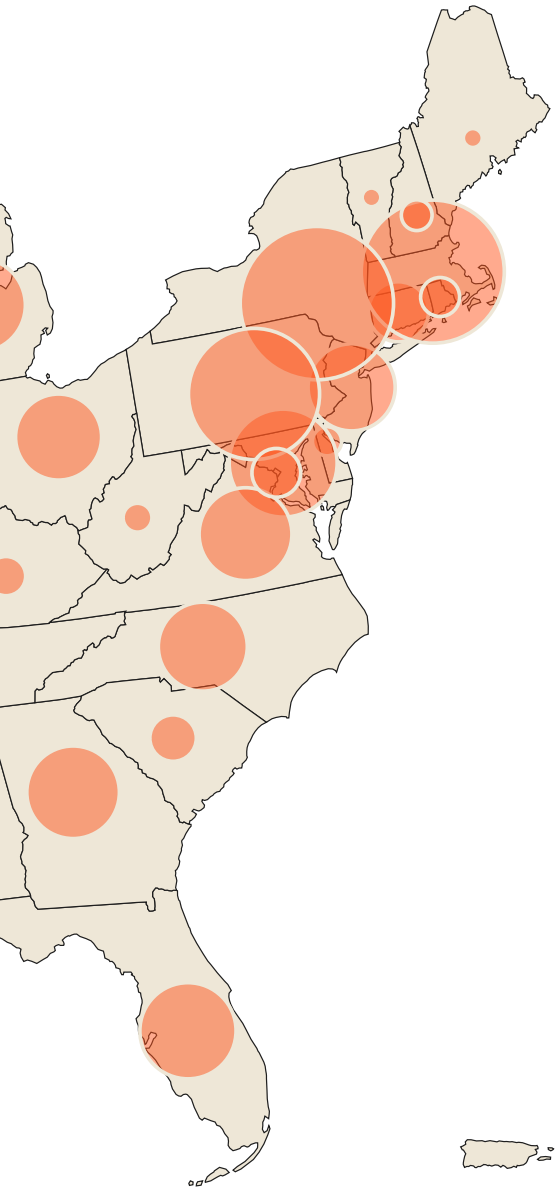
Credit: Elsevier



US publications by state in artificial intelligence

Another way to understand the scope of US academic contributions to US research output is to examine the geographic distribution across the US.

The image shows the geographic distribution of US academic contributions in artificial intelligence. The size of the bubbles are relative to the volume of research outputs from each state.

While publication volume is closely tied to the size and number of researchers and research organizations within a state, there are variations across the country.

To explore the geographic distribution maps for the other technology areas, please visit the online version at: elsevier.shorthandstories.com/us-research-and-innovation-performance/index.html

Conclusion

The data in this dashboard illustrates the comprehensive breadth and depth of science and technology research in the US This strong ecosystem has allowed US researchers to have significant impact in critical and emerging technology areas.

The US advantage, among other globally competitive nations, is bolstered by industry-academic collaboration.

In the evolving landscape of global science and technology research, the insights provided by Elsevier through SciVal and the Scopus database can serve as valuable resources for university, industry and government stakeholders. Through these resources, we can better understand research trends, identify emerging research directions, and evaluate the influence and significance of research investments.

We invite you to explore these insights further and consider how they can inform future strategies for growth and collaboration in the US research community.

Elsevier welcomes use of this data. Please feel free to use the charts and download the data, noting the source and citing Elsevier when using them. Thank you.

If you have any questions or would like to know more about Scopus or SciVal, please contact Elsevier.

"Elsevier is pleased to share this dashboard of information on the US research and innovation landscape. Research and development activities are not just about scientific knowledge-building or advancement – they are central to economic development, competitiveness, and security. Investments by the United States across a wide range of disciplines and domains for many decades have enabled the US to emerge as a leader in many critical and emerging technology fields.

These data demonstrate the critical roles of US industry and academia in these emerging fields and the positive effect of industry-academic collaboration. The impact of this research extends across the Nation, in every state, and helps to shape both future innovations and global policy."

Dr. Nimmi Kannankutty, Vice President, Academic Relations, North America, Elsevier

Glossary

Citation

A citation is a formal reference to earlier work made in, for example, a publication or patent. A citation is used to acknowledge sources you have used and so credit the authors, avoid plagiarism and to enable the original source to be located. The number of citations received by a publication from subsequently published outputs can be used as a proxy of the quality or importance of the reported research.

Field-Weighted Citation Impact (FWCI)

FWCI is a normalized citation impact metric, that allows entities across disciplines to be directly compared. It is calculated by comparing the actual number of citations received by each of an entity's publications, relative to the expected world average for similar publications in terms of the discipline, publication type and publication year. A FWCI of 1.00 indicates that the entity's publications have been cited on par with the global average for similar publications, more than 1.00 indicates citations above the global average and less than one, less than the global average.

Industry-Academic Collaboration

Industry-Academic collaboration in this report is indicated by publications with at least one author from an industry organization and one author from an academic institution listed in the authorship byline.

Mapping publications to technology areas

The mapping of publications to technology areas relied on the semantic alignment between the titles and abstracts of the publications and the research areas defined within each technology areas. To achieve this, Elsevier employed an AI-powered methodology designed to classify research publications according to their relevance to research domains.

Relative Activity Index (RAI)

Relative Activity Index is defined as the share of an entity's publications in a subject area, relative to the global share of publications in the same subject. A value of 1.0 indicates that an entity's research activity in a field corresponds exactly with the global activity in that field; higher than 1.0 implies a greater emphasis while lower than 1.0 suggests a lesser focus.

Research and development (R&D) intensity

A measure of gross domestic expenditures on research and development (R&D), expressed as a percent of GDP. They include both capital and current expenditures in the four main sectors: Business enterprise, Government, Higher education and Private non-profit. R&D covers basic research, applied research, and experimental development.