Institute for Scientific Information

The annual G20 scorecard – Research and innovation performance 2024

Executive summary

Gordon Rogers

Clarivate™

Author biography

Gordon Rogers is a Senior Manager, Data Science at the Institute for Scientific Information™. He has worked in the fields of bibliometrics, data analysis and software engineering for more than 20 years at Clarivate and its former parent company. As a former member of our Consultancy team, he has supported clients around the world in evaluating their research portfolio and strategy. ORCiD: 0000-0002-9971-2731. Web of Science™ ResearcherID: ABA-6554-2020.

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About the Institute for Scientific Information

The Institute for Scientific Information at Clarivate™ has pioneered the organization of the world's research information for more than half a century. Today it remains committed to promoting integrity in research while improving the retrieval, interpretation and utility of scientific information.

It maintains the knowledge corpus upon which the Web of Science™ index and related information and analytical content and services are built. It disseminates that knowledge externally through events, conferences and publications while conducting primary research to sustain, extend and improve the knowledge base.

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Introduction

The Institute for Scientific Information (ISI) promotes a responsible and meaningful assessment of research and advocates for a review of comprehensive research profiles and use of indicators that capture broad contributions of quality and impact.

Our annual G20 report exemplifies this approach by assessing the research and innovation outputs of each G20 member. The G20, as "the main forum for international economic cooperation" should reflect strong research and technology bases. This report presents multiple data points to help evaluate the research performance of the nineteen member states and the European Union (EU) – the twentieth member of the G20. The 2023 G20 summit in India welcomed the African Union (AU) as an additional permanent member and so we have also included information on these two unions in this report. As a result, the G20 group now represents nearly 80% of the global population, nearly 85% of global GDP and more than 90% of published research papers. Each member contributes uniquely to research and innovation, which we illustrate through various interactive visualizations that highlight their individual strengths.

Research performance should not be solely measured by citation counts. Research should have a tangible impact on society. One area worth reviewing is patent activity. Many patents build on academic research and prior G20 reports have included data on patent filing activity with the World Intellectual Property Organization. This year, for the first time, our report now includes a new indicator to measure the number of citations each paper receives from related patents. Of course, just as paper-to-paper citations increase over time, so too do patent-to-paper citations, so we have normalized the total against the average number of citations received by all papers published in the same year. We call this the Normalized Patent Citation Impact™.

The theme of this year's G20 summit in Rio de Janeiro, Brazil, "Building a just world and a sustainable planet" aligns with the United Nation's Sustainable Development Goals (SDGs), as part of their 2030 Agenda. Last year's report included an analysis on each member's research contribution to tackling these goals. Our 2024 report expands on our previous analysis to include data on the collaborative and accessible nature of this research.

Over the past few decades, global research has become increasingly collaborative; where once North America and Europe dominated the global research network, new regional hubs are now shifting the balance towards Asia, Latin America and the Middle East. This year we include new analyses on these shifting patterns, identifying the leading collaborators for each G20 member and the citation impact of their joint outputs.

This G20 report is part of the Global Research Report and Insights series from the Institute for Scientific Information, all freely available to download on our site. Recent reports in the series include: Making it count, China's research landscape, Research impact in society and the economy and U.S. research trends.

While we encourage you to view the dynamic online content for a richer experience, we provide a small snapshot of each member's performance here:

Key:

BERD	Business Sector Expenditure on R&D
CNCI	Category Normalized Citation Impact — a standard method that compares the accumulated citation count for an article (or a review) to other articles (or reviews) published in the same year and in the same journal based subject category in the Web of Science.
Collab-CNCI	Collaborative CNCI — whereby the accumulated citation count for each paper is normalized against other papers of the same publication year, the same subject category, the same document type and – critically – the same collaboration type.
GDP	Gross Domestic Product
GERD	Gross National Expenditure on R&D
SDG	Sustainable Development Goals

G20 member's performance

African Union	
Population	Largest member by population, lowest GDP per capita.
Collaboration	Most research involves external partners; 60% with non-members of the AU; less than 3% between AU members.
Citation impact	Medical research CNCI is 1.1.
SDGs	Priorities include No Poverty (SDG 1) and Gender Equality (SDG 5).
Partners	Saudi Arabia is now the lead collaborator, replacing the U.S., while collaborations with Mainland China yield higher citation impact.
Argentina	
Gender	Proportion of female researchers remains above 50%.
Research density	Low at around 2 researchers per thousand people.
Citation impact	CNCI has risen above the world average of 1.0 in most recent years; Collaborative CNCI lower at ~0.7.
Normalized Patent Citation Impact	High in Medicine, around 1.6 times the world average.
Open access	Humanities output thrice the G20 average.
Partners	Strong ties with Spain and Brazil.

Australia	
Citation impact	CNCI remains high at 1.4; Collaborative CNCI also high at 1.1.
Normalized Patent Citation Impact	Engineering and Technology output 1.6 times the world average.
Trends	International output rising but leveling off recently.
Partners	Leading partners include the U.S., Mainland China, the U.K. and neighbour, New Zealand – their tenth most frequent collaborative partner over the period.
Brazil	
Open access	Output stable at 40%; was above the G20 average but has failed to keep pace as other members have increased their percentages.
SDGs	Focus on Zero Hunger (SDG 1) and Life on Land (SDG 15) with impact around 0.7 times the world average.
Canada	
Normalized Patent Citation Impact	Overall at 1.3 times the world average; Engineering and Technology at twice the average.
Collaboration	30% of papers with the U.S. - the highest proportion for any collaboration by a G20 member; strong CNCI performance in collaborations with the U.K., Germany and France.
China, Mainland	
Collaboration	Remains low at ~20%; the U.S. remains most frequent partner, though percentage has halved over the decade from 12% to 6%. Around three-quarters of their international collaborations are bilateral.
Normalized Patent Citation Impact	Above world average.
Patents	Performance is very high — more than 1.5 million patents filed with WIPO in 2022, more than 2,500 patents per million international dollars of business enterprise expenditure on Research & Development (BERD (million PPP$)).

* Mainland China includes data from Hong Kong SAR and Macau SAR.

European Union	
Output	Largest contributor of papers than any other G20 member - 5.2 million papers.
Collaboration	10% within the EU, 40% with external partners.
Open access	Now more than 10 percentage points higher than the G20 average.
SDGs	Focus on Reduced Inequalities (SDG 10) and Partnerships for the Goals (SDG 17) although impact is below the world average for both.
Partners	Leading partners include the U.S, Mainland China and the U.K., which was still part of the EU for much of the period.
France	
Normalized Patent Citation Impact	Remains above world average over past decade, particularly strong in Medicine (~2).
Citation impact	High CNCI in Medicine; Collaborative CNCI around average.
Open access	Output stable, G20 average catching up.
Partners	While more than half of their international collaborations are bilateral, their collaborations with their most frequent partners tend to be part of larger collaborations.
Germany	
Research density	Proportion of researchers remains high at 8.3 researchers per thousand people.
Citation impact	High CNCI for collaborative papers at 1.48 times the world average; Collaborative CNCI around world average.
Normalized Patent Citation Impact	Around twice the world average in Medicine, high in Life Sciences and Engineering.
Open access	More than 60% of papers (2023).

India	
Collaboration	International collaboration has increased from nearly a quarter (23.3%) to just over one third (35.6%) over the decade.
Partners	Leading collaborator is the U.S., however increase in international collaboration is driven by collaborations with Saudi Arabia, the U.K., Mainland China and South Korea. Collaborations with Mainland China produce the highest impact among these five countries/regions at around 1.5 times the world average for Collaborative CNCI.
SDGs	Focus on Clean Energy (SDG 7), Responsible Consumption (SDG 12) and Clean Water (SDG 6), however their output in Economic Growth (SDG 8) and Industry (SDG 9) are the most impactful.
Indonesia	
Collaboration	International collaboration fallen from above 80% to just above 60% with signs of leveling off as Indonesia has built up its domestic research base.
Partners	Japan, Australia, the U.S. and rising collaborations with Malaysia, now the leading partner.
SDGs	Strong focus on No Poverty (SDG 1), (at 4.3 times the G20 average proportion), with even higher focus on OA papers in this SDG (5.9 times the G20 average proportion).
Italy	
Citation impact	CNCI is 1.3 times the world average by 2023; Collaborative CNCI around average.
Open access	Output nearing 70% — ahead of G20 average.
Focus	Research in Medicine (1.5 times the G20 average proportion) highly cited by both papers and patents at 1.5 and 1.4 times the world average respectively.
SDGs	Partnerships for the Goals (SDG 17), although this output is not as well cited as their output in other SDGs.
Japan	
Collaboration	Remains below 40%, with the U.S. and Mainland China as strongest partners, with the latter likely to overtake the former in the next few years.
Gender	Low female researcher percentage (<20%).
Patents	High patent output. Around 2,500 patents per BERD (million PPP$) in 2022, among the highest in the G20.
Citation impact	CNCI low in most fields, but rising in Medicine and allied subjects, Engineering, Social Sciences. Patent to papers citation impact, however, is high in Life Sciences and Engineering at around 1.5 and 1.3 times the world average respectively.

Mexico	
Collaboration	Just below the G20 average at just below 50%.
Partners	Most productive partners are the U.S. and Spain, with Brazil and Colombia at numbers 6 and 10 reflecting strong geographic and linguistic ties.
Research density	Low at 0.4 researchers per thousand people.
Focus	Strong focus on Life Sciences (1.5 times the G20 average proportion), but of relatively low impact (CNCI around 0.7); Medicine — performs better than Life Sciences at 1.4 times world average impact, but focus is only 0.7 times the G20 average proportion.
SDGs	Life on Land (SDG 15) and Life below Water (SDG 14) receive a lot of attention, as does Zero Hunger (SDG 2).
Russia	
Collaboration	Below average, declined in 2022 and 2023 and loss of most productive collaborations, with the U.S and Germany; leading partner now Mainland China.
Citation impact	High CNCI and Normalized Patent Citation Impact in Medicine, at 1.4 and 1.7 times the world average respectively, due to collaboration.
Focus	Greater on Mathematics and Physical Sciences (around 1.7 times the G20 average).
Impact	Nearly 25% of their domestic output remains uncited.
Saudi Arabia	
Collaboration	International collaboration remains high at more than 80%; leading partners are Egypt, Pakistan, India and Mainland China. Collaborations with Egypt have driven an increase in collaborative impact from 0.9 to 1.1 times the world average overall.
SDGs	Focus on Economic Growth (SDG 8) is modest at 0.8 times the G20 average proportion, however it is highly cited with a citation impact of 2.3.

South Africa	
Gender	Nearly 50% female researchers — although only around 1 in 1,000 of the population are researchers.
Collaboration	Remains high, rising to 70%, with strong ties to the U.S. and the U.K.
Open access	~66% of output.
SDGs	Strong focus on No Poverty (SDG 1), Education (SDG 4) and Peace & Justice (SDG 16), while output in Good Health (3), Industry (9), Gender Equality (5) and Sustainable Cities (11) tends to have higher impact.
Focus	Humanities & Languages and Social Sciences are both high (2.3 and 1.8 times the G20 average proportion respectively). The proportion of Open Access output in both of these subject areas is especially high compared with the G20 average (3.5 and 2.0 times, respectively).
South Korea	
Investment	High GERD per GDP at 5.2% and patents per BERD (million PPP$) at around 2,500.
Output	International output below average, rising to 40%.
Citation impact	High Normalized Patent Citation Impact in Engineering and Life Sciences; strong contributions from Medicine and Mathematical and Physical Sciences.
Partners	Collaborations with the U.S. have fallen, those with Mainland China and India are rising.
SDGs	Strong focus on Clean Energy (SDG 7), Partnerships for the Goals (SDG 17) and Sustainable Cities (SDG 11), however most of the output is at or below world average impact. Notable exception is high Normalized Patent Citation Impact in Good Health (SDG 3) and Sustainable Cities (SDG 11), at around 1.6 and 1.4 times the world average respectively.
Türkiye	
SDGs	Strong focus on Economic Growth (SDG 8) 1.6 times the G20 average proportion — with high citation impact (~2.4 times the world average).
Collaboration	International collaboration is generally low, having risen to just over 30% over the decade.
Partners	Leading partners include the US., the U.K., plus geographic ties to neighbours Iran, Saudi Arabia and India.

United Kingdom	
Citation impact	High CNCI at 1.4 times world average; Collaborative CNCI at 1.1.
Collaboration	Rose from below 60% in 2015 to over 70% since 2022.
Partners	Leading partners in the U.S., Germany and increasingly, Mainland China.
Normalized Patent Citation Impact	Strong in Engineering and Technology, Medicine and Life Sciences at 1.8-1.9 times the world average, and high paper citation impact in Medicine of 1.7.
SDGs	Strong focus on Peace & Justice (SDG 16) and Reduced Inequalities (SDG 10), both more than twice the G20 average proportion.
United States	
Normalized Patent Citation Impact	Very high in Life Sciences (2.6 times world average), Engineering and Technology (2.5) and Medicine (2.1).
SDGs	Strong focus on Peace & Justice (SDG 16) and Reduced Inequalities (SDG 10) in terms of paper output and a strong focus on Good Health (SDG 3) and Clean Energy (SDG 7) in terms of citation impact from patents.
Partners	Below average, leading partner is Mainland China, predominantly through bilateral partnerships.

Explore the interactive 2024 G20 scorecard at: https://clarivate.com/the-institute-for-scientific-information/2024-g20-scorecard/

About the Global Research Report series from the Institute for Scientific Information

Our Global Research Reports draw on our unique industry insights to offer insights, analysis, ideas and commentary to enlighten and stimulate debate.

Each one in the series demonstrates the huge potential of research data to inform management issues in research assessment and research policy and to accelerate development of the global research base.

Advice on the use of the standard methodology and information about comparative institutional analyses used in this report is available.

Email: **isi@clarivate.com**

Previous reports include:

The Annual G20 Scorecard – Research Performance 2023

Research impact in society and the economy

China's research landscape

U.S. research trends: The impact of globalization and collaboration

Unpacking research profiles: Moving beyond metrics

Research assessment: Origins, evolution, outcomes

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