

East & Southeast Asia

While remaining strong in chemistry and physical sciences, buoyed by China's growing contribution, the region embarks on collaborations that could extend its reach.

ARTICLE COUNT (AC): 16,277
 FRACTIONAL COUNT (FC): 12,092
 WEIGHTED FRACTIONAL COUNT (WFC): 11,464

East & Southeast Asia was the third largest regional contributor to the Index behind North America and North & West Europe. Its 2014 WFC of 11,464 is a 6% increase from 2013. China, the second-ranked country in the global Index, increased its WFC by 16% over 2013. In comparison, North America's WFC decreased by 4% and North & West Europe's dropped, too, but by less than 1%.

"China is growing much, much faster than the US," says Derek Hill, a science resources analyst at the National Science Foundation (NSF). "And China has been investing enormous resources in education and research and development."

Overall, the scientific output from East & Southeast Asia reflects the economic status of the region. The combined GDP of these countries makes up about 22% of the global GDP. Likewise, this region accounts for 22% of the Nature Index's weighted fractional count (WFC) for 2014. For comparison, North America accounts for about 24% of the world's GDP, yet it produces 38% of the Index's total WFC.

One area in which East & Southeast Asia dominates the Index is the output of chemistry. The region's chemistry WFC in 2014 of 6,062 makes up one-third of the global output in this field. Physical sciences represent the region's second highest area of publishing output in the



In Nanjing, China, BASF and Sinopec collaborate to increase the production of agricultural chemicals.

Index, but only reach about the global aggregate in terms of the percentage of the region's total WFC. The region's contributions to the Index in both life sciences and earth and environmental sciences are about half the equivalent proportions that those areas contribute to the global aggregate WFC. Among articles in the 2015 Index, scientists in East & Southeast Asia collaborate with scientists in other countries in about 25% of projects.

In earth and environmental sciences, though, the scientists in the region collaborate 80% of the time. All of the regions in the Index collaborate most in this subject category.

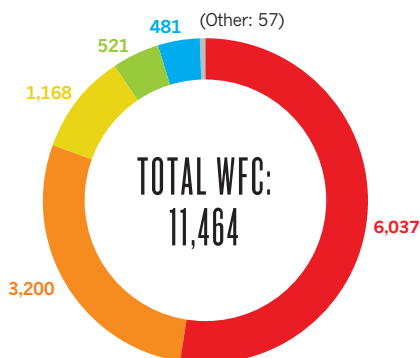
THE TRADITIONAL TOP THREE

China dominates East & Southeast Asia's Index performance: its WFC of 6,037 accounts for exactly half of the region's publishing output. Second-placed Japan, with a WFC

EAST & SOUTHEAST ASIA ANALYSIS

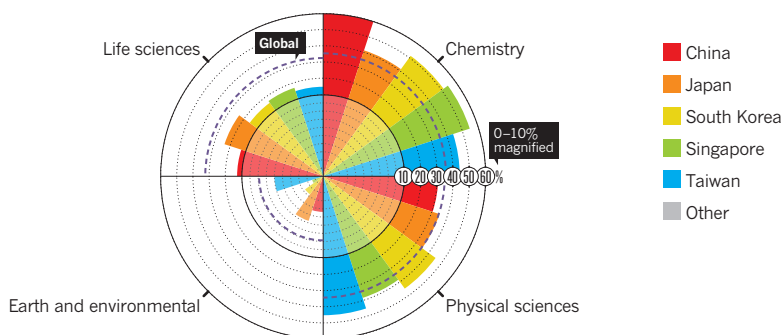
Countries' weighted fractional count (WFC)

In combination, China and Japan produced more than 80% of this region's contribution to the Index.



Relative subject area distribution

More than 80% of the publications from the Index explore chemistry or physical sciences.*



*Each slice represents the proportion each subject area contributes to a country's overall WFC. Subject areas can overlap, so the total percentage may exceed 100%.



BASF-YPC Company's low-density polyethylene plant produces 400,000 metric tons a year.

other leading countries in the region. Of Japan's WFC from 2014 articles in the Index, 41% and 35% come from chemistry and physical sciences. For South Korea, chemistry and physical sciences provide 51% and 46% of its WFC.

When scientists in East & Southeast Asia collaborate internationally, they tend to look to the west. In fact, 45% of collaborations are with scientists from North America. The second most likely source of collaborators, accounting for 28% of them, is North & West Europe. Other scientists from the same region only make up 18% of international collaborations, and other parts of Asia add only a few percent of the collaborators.

“CHINA WILL REMAIN THE DOMINANT GLOBAL FORCE FOR CHEMICALS BEYOND 2020.”

CUTTING-EDGE INSTITUTIONS

By far the region's top institutional contributor to the Index is the massive Chinese Academy of Science (CAS), which takes the number one spot in the world. Its WFC of 1,308 — up by 8.1% since 2013 — is more than 50% higher than second-placed Harvard's and accounts for 2.6% of the global output. Like China in general, CAS published strongly in chemistry and physical sciences, with WFCs of 771 and 413 leading the world in these disciplines. One example of CAS's physical sciences prowess can be found in a 2014 *Nature* article by two CAS researchers and 11 other authors. The paper shows that single-atom layers of graphene, as well as of hexagonal boron nitride, have unexpectedly high permeability to protons at room temperature. This permeability makes such monolayer crystals “promising candidates for use in many hydrogen-based technologies,” the authors conclude.

of 3,200, makes up another quarter. Third-placed South Korea was responsible for 10% of the region's WFC. Contributions from other countries split up the remaining 15%, with none of them providing even 5% of the output in the Index.

The top three country contributors to the Index from this region are very strong in high-quality chemistry and physical sciences research. Chemistry accounts for a whopping 60.3% of China's WFC; the global aggregate is 35.6%.

China's research in chemistry covers applied and basic science. In the March *Journal of the American Chemical Society*, for example, scientists from China's Wuhan University and

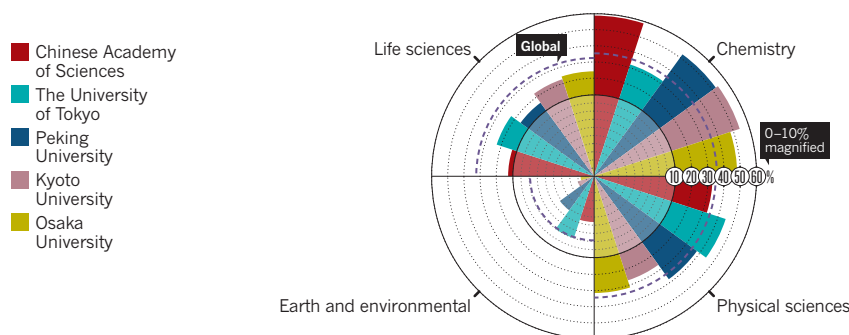
Central China Normal University described the synthesis and crystal structure of a non-linear optical material that resists damage from lasers. The Index articles for 2014 also include a January paper in *Inorganic Chemistry* in which scientists from China's Jiangsu University revealed new magnetic properties of iron compounds.

In addition to extensive publishing on chemistry in 2014 data in the Index, US-based IHS Chemical, which offers industry marketing information and technical expertise, says that Asia — especially China — “will remain the dominant global force for chemicals beyond 2020.”

Similar research concentrations exist in

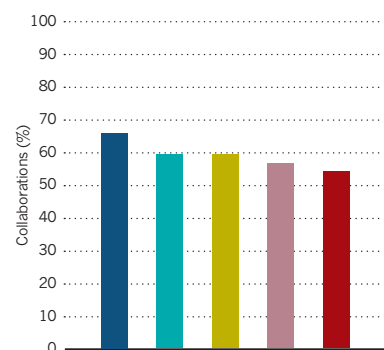
EAST & SOUTHEAST ASIA ANALYSIS

Top 5 institutions' relative subject area distribution
Chemistry articles made up more than half of this region's output, and the Chinese Academy of Sciences led this category globally.*



*Each slice represents the proportion each subject area contributes to an institution's overall WFC. Subject areas can overlap, so the total percentage may exceed 100%.

Top 5 institutions' collaborativeness
The Chinese Academy of Sciences published the most but collaborated the least among the leading institutions.*



*Each bar represents the proportion of an institution's overall output in the Index (AC) stemming from domestic and international collaborations.

GETTY



Scientists at the Chinese Academy of Science, which has the highest institutional WFC in the Index, explore basic and applied science, including clinical research.

Japan's University of Tokyo came in second amongst the region's institutions. Its WFC of 456 placed it at number 7 globally. Like CAS, this university published largely on chemistry and physical sciences, with respective WFCs of 144 and 205.

Relatively speaking, this university puts more emphasis on the life sciences than CAS, with a WFC of 99. In addition, about 8% of the University of Tokyo's WFC goes to articles in earth and environmental sciences, which is about the proportion of the global aggregate WFC in this area.

For example, University of Tokyo earth scientist Masumoto Yukio and his colleagues reported in *Nature* in 2014 on the impact

of global warming in currents in the Indian Ocean. They noted that ongoing changes will continue to drive more extreme weather.

The region's number three institution, China's Peking University, generated a 2014 WFC of 292, and came in 17th globally. Like CAS and the University of Tokyo, Peking University focuses on chemistry and physical sciences.

In addition, this university relies on collaborations to expand its strengths in other areas. For example, Peking University Clinical Research Institute (PUCRI) maintains an ongoing collaboration with New York-based Medidata, which provides cloud-based, life science solutions.

Many companies in China, who still keep

track of clinical trials on paper, will be able to utilize Medidata's electronic systems. Takeru Yamamoto, Medidata's managing director of Asia-Pacific region, says, "Our goal remains to enhance the speed and operational efficiencies of clinical studies, so that we can enable life science companies to bring new therapies to patients more quickly — both from the local market and around the world."

“OUR GOAL REMAINS TO ENHANCE THE SPEED AND EFFICIENCIES OF CLINICAL STUDIES.”

SPREADING EXPLORATIONS

China contributed 147 articles in *Nature* and *Science* in 2014 — the most for the region, just ahead of Japan with 137. Some of China's output that landed in these high-profile publications came from areas outside its typical focus on chemistry and physical sciences.

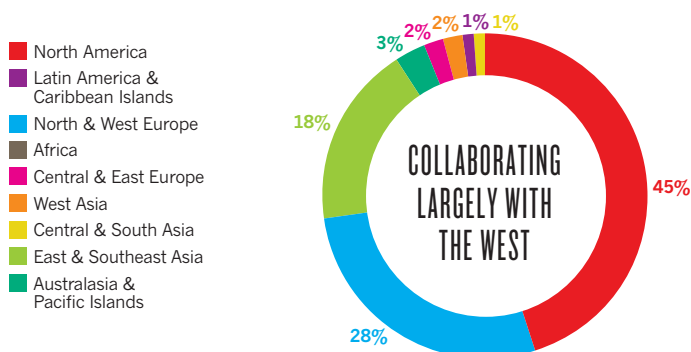
In the October *Nature*, for example, a group of researchers from various institutions in China and one in the United States, reported on the best methods of crop management to produce more food with fewer environmental consequences. In addition, some of these articles combine China's strength in chemistry with other areas. As an example, a July *Nature* article from researchers at the Chinese Academy of Sciences and the University of Science and Technology of China explored the biochemistry of lipids in search of clinical targets for fighting bacterial infection.

These researchers, as well as others across East & Southeast Asia, are thus using their foundational strength in chemical sciences to study not only that area but a host of related ones. Such work is fuelling the remarkably robust surge in the region's scientific research, as reflected in a rising WFC in the Index. ■

EAST & SOUTHEAST ASIA ANALYSIS

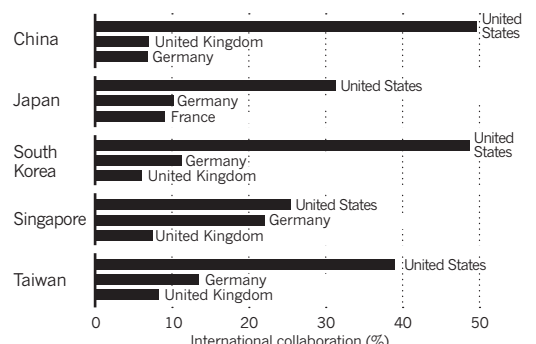
International collaborations

Nearly half of the region's collaborators work in North America, and more than a quarter come from North & West Europe.



Top 3 country collaborations

In China, Japan, South Korea and Taiwan, papers with US coauthors account for more than 30% of such international collaborations' WFC.*



*Bars represent international collaboration rates between countries as a proportion of the total output (WFC) stemming from international collaborative efforts.