

Roadmap for cooperation on research and education with China 2018–2020

This roadmap summarises the status of cooperation on research and education with China and identifies which thematic areas are particularly relevant as a basis for cooperation in the years ahead.

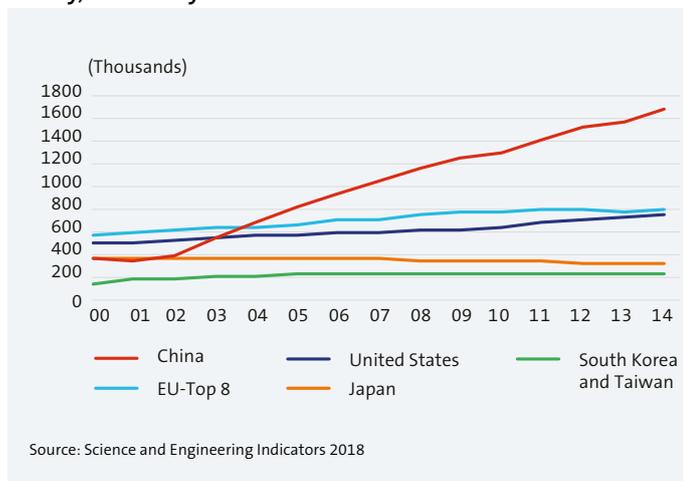
- > In 2016, China surpassed the US in terms of published research in science and engineering.
- > Since 2000 China has greatly increased its share of publications in the world's top 1% cited S&E publications.
- > China has doubled its investment in research activities in terms of share of GDP, from one per cent in 2001 to more than two per cent in 2015. China's GDP has grown tenfold during the same period.
- > Since 2000, the annual number of PhDs in China has quadrupled to 40 000.

World's largest educational system

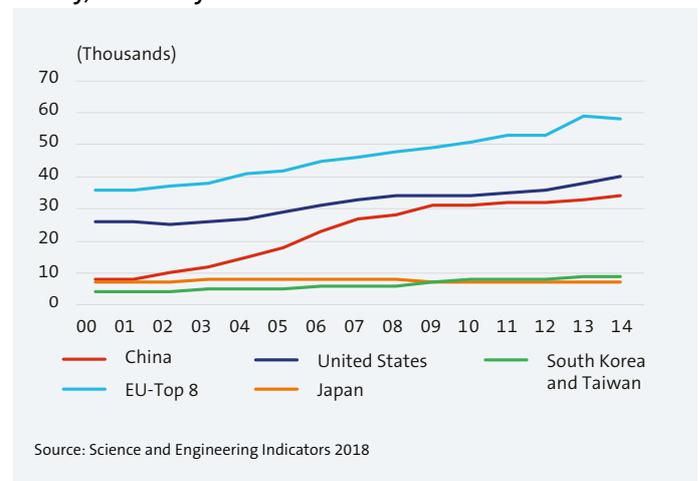
- > China is home to the world's largest educational system, awarding twice as many bachelor's degrees as the US each year.
- > The number of ordinary higher education institutions in China increased from 1 071 in 1999 to 2 596 in 2016.
- > China's student population grew from 8.8 million in 1999 to 29 million in 2016.
- > Each year 15 000 engineers earn a PhD, the most of any country in the world.



Bachelor's degree awards in S&E fields, by selected region, country, or economy: 2000–14



Doctoral degree awards in S&E fields, by selected region, country, or economy: 2000–14



In 2017
8 000 000
students graduated from Chinese universities.

Since 2000, China has quadrupled its annual number of PhDs

China has doubled its investment in research activities in terms of share of GDP, from **one per cent** in 2001 to more than **two per cent** in 2015

Thematic areas for research collaboration



Sustainable urbanisation



Environment-friendly energy



Climate, the environment and the polar regions



Sustainable agriculture



Sustainable aquaculture



Carbon capture and storage (CCS)



Digitalisation



Health innovations



Maritime activities



Social sciences and humanities



Cooperation on infrastructure

Why China?

- > China has the world's largest educational system and is an increasingly important research nation. Cooperation with China is important to ensure that Norwegian research and educational institutions have access to excellent research groups.
- > China's contribution is essential to solve global challenges in areas such as poverty reduction, climate, health, energy and the environment.
- > Cooperation with relevant partners in China can lead to a more innovative and competitive Norwegian business sector.
- > Cooperation on research and education can provide access to China as a market for the Norwegian businesses.

Norway and China

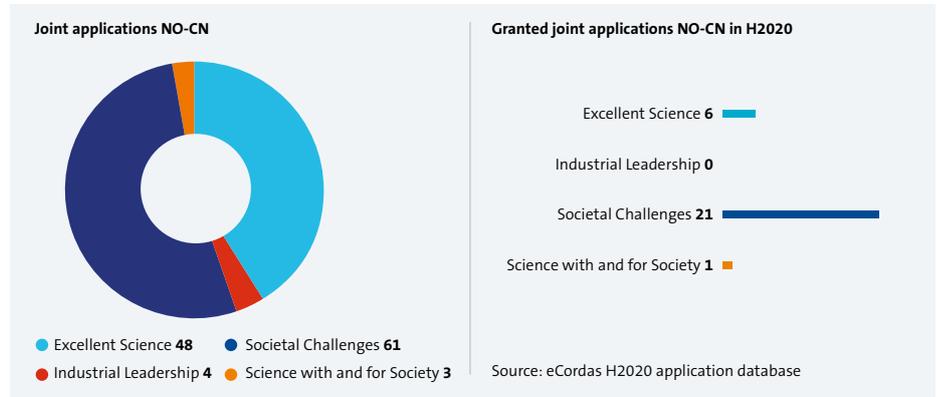
- > The number of co-publications between China and Norway has increased significantly in the past 15 years.
- > Health, ICT, the environment and biotechnology stand out as areas with the most Norwegian-Chinese cooperation over the same period.

Student mobility

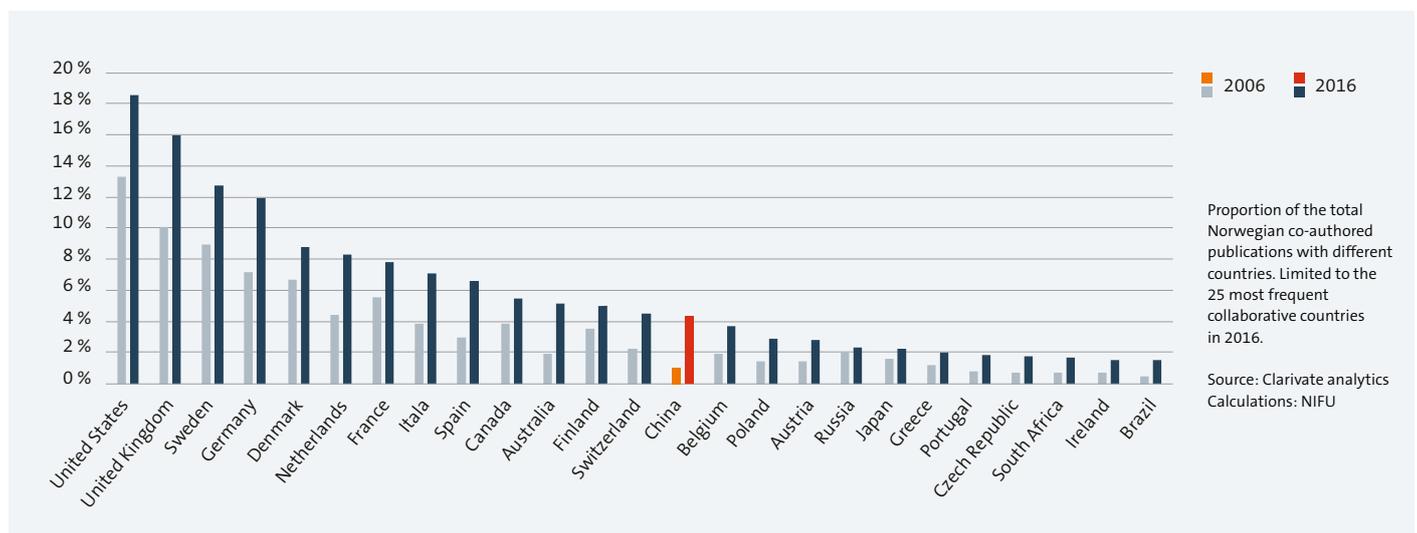
- > Over the past five years, the number of exchange students from Norway in China has varied between 100 and 140, while between 120 and 150 Chinese exchange students have been studying in Norway. Approximately 1 000 students with Chinese citizenship are registered at Norwegian institutions as regular students. This number has been stable for

the last five years. More information about student mobility and Norwegian-Chinese cooperation on education is available on the [statistics webpages](#) of the Norwegian Centre for International Cooperation in Education (SIU).

Norway – China applications to Horizon 2020 per October 2017



Co-authorship between Norway and other countries



China as a higher education nation

Education is a cornerstone of China's innovation strategy, with a comprehensive effort to boost both capacity and quality. China has the world's largest educational system, and its ambition is to be world leading by 2050. Internationalisation is vital to achieving that.

[Higher education](#) in China has undergone phenomenal growth since the turn of the millennium. The STEM subject fields (science, technology, engineering and mathematics) dominate China's educational landscape, and 30–40 per cent of master's and PhD students study engineering.

Most Chinese educational institutions are public. Some of these are placed directly under national authorities but most of them are administered by provincial authorities. Master's and PhD level degrees are also available at over 200 research institutions. Support for public institutions comes from differentiated resources, such as public funding, tuition fees, commercial activities and private donations. There are also semi-private institutions.

The sector is highly stratified. At the top are the few elite institutions, primarily located in the urbanised regions of Eastern China. The provincial universities make up the middle tier, while the lowest tier is comprised of a great many local vocational schools and higher education institutions for adults.

Quality and relevance

Enhancing the quality of education is high on China's educational-policy agenda.

[China's long-term plan for education \(2010–2020\)](#) sets out various measures: more problem-oriented and participatory teaching activities, linking education to research and practice, interdisciplinarity, institutionally guaranteed educational quality, and investment in infrastructure and more teachers.

[The 13th Five-Year Plan \(2016–2020\)](#) stresses the universities' contributions to innovation.

Educational programmes are to promote creativity and entrepreneurship. Several universities now offer designated entrepreneurship programmes. China is seeking to strengthen its educational quality, teacher education and entrepreneurship education through international cooperation.

World-class universities

China is investing heavily in developing world-class universities, and in 2015 launched the Double World-Class Project to provide additional resources for selected institutions and disciplines. In 2017 China released a list of [42 selected universities, with another 95 universities planned to have world-class disciplines](#). The project builds on previous elite initiatives, namely the 211 Project from 1995 encompassing selected disciplines and some 100 institutions, and the 985 Project from 1998 encompassing 39 institutions. The newest project includes all the institutions from the 211 and 985 projects.

Internationalisation of Chinese higher education

It is a stated goal to increase both incoming and outgoing student mobility. [The number of courses taught in English](#) is rising, and the target for 2020 is to recruit 500 000 international students.

Many international actors have established study programmes on Chinese campuses in cooperation with Chinese universities. China is also working to establish Chinese campuses abroad, and education is a priority area under China's global strategy for infrastructure and trade, the [Belt and Road Initiative](#).



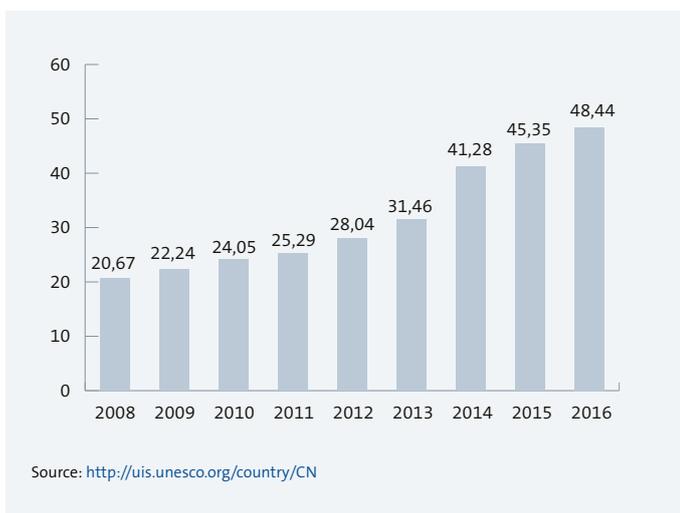
Norwegian priorities

[The Norwegian Government's Panorama strategy for cooperation on higher education and research with the BRICS countries \(Brazil, Russia, India, China and South Africa\) and Japan](#) stresses that educational cooperation and student mobility must take place within the framework of broader scientific and institutional cooperation. It is an objective to link educational cooperation to research cooperation, working life and the private sector.

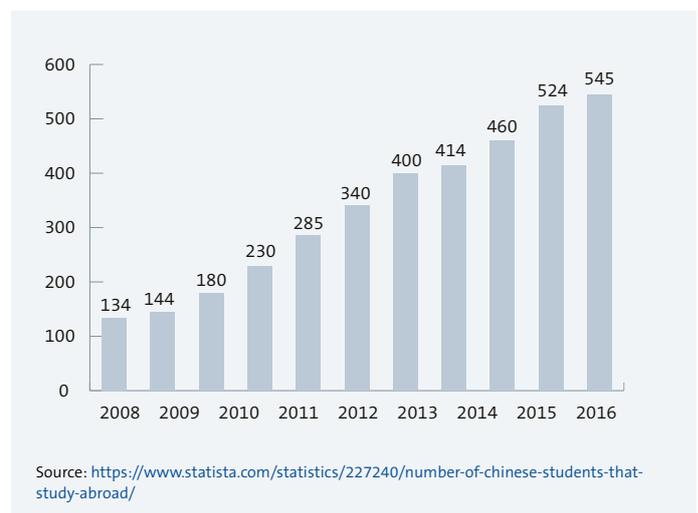
A new bilateral action plan for Sino-Norwegian educational cooperation comprises important priorities. The cooperation will be implemented through annual meetings at ministerial level, joint calls and mutual recognition of degrees.

The UTFORSK Partnership Programme and the International Partnerships for Excellent Education and Research (INTPART) programme, administered by the SIU (Norwegian Centre for international cooperation in education) and the Research Council, respectively, are measures established under the Panorama strategy to promote institutional cooperation and closer links between higher education and research. A priority objective for Norway's educational cooperation with China is to expand student exchange. SIU has developed a [resources webpage](#) to support efforts to increase student mobility.

Chinese students in higher education (Gross enrolment rate)



Chinese students abroad (1000)



China as a research and innovation nation

China's overarching objective for international research cooperation is to open up its own R&D system for cooperation and exchange. Through openness to the world, China seeks to take part in the international forefront of research and innovation and to attract global resources.

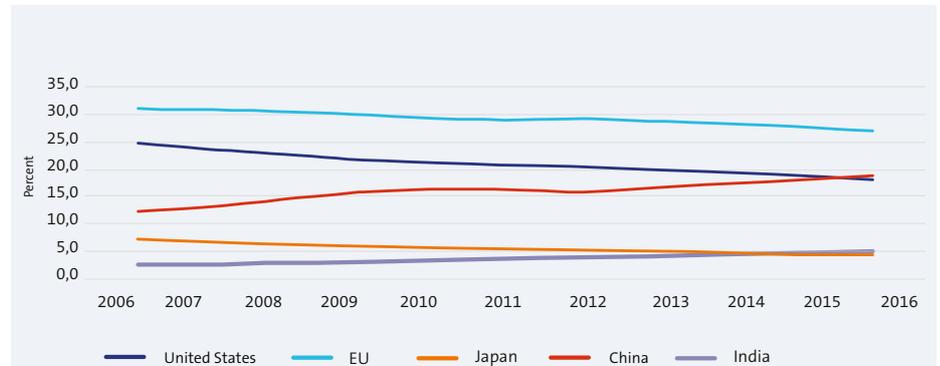
The university sector

The national university sector is a main policy instrument for the development of modern China. According to the [13th Five-Year Plan \(2016–2020\)](#), innovation is to lay the foundation for future Chinese growth, and the role of the educational system is to produce innovators. Currently, China's research system consists of roughly 2 500 national universities and university colleges, 100 research institutes affiliated with the Chinese Academy of Sciences (CAS), and a number of other research institutes affiliated with other academies and sectoral ministries. In recent years China has undergone restructuring of national R&D funding governance, and expanded its competitive arenas.



Currently, China's research system consists of roughly **2500** national universities and university colleges

S&E articles by global share



Source: National Science Foundation, National Center for Science and Engineering Statistics; SRI International; Science-Metrix; Elsevier, Scopus abstract and citation database, accessed July 2017.



Foto: Shutterstock



Foto: Shutterstock

National research-funding institutions

Photo: Ministry of Education and Research



In the summer of 2017 Norwegian Minister of Education and Research, Torbjørn Røe Isaksen and Chinese Minister of Science and Technology, Dr. Wan Gang signed a new action plan for collaboration on research, technology and innovation.

The [Ministry of Science and Technology \(MOST\)](#) also operates as a funding body. The MOST provides funding to large-scale projects in national priority areas, large-scale infrastructure, and international collaboration, all linked to national policy objectives.

The [Chinese Academy of Sciences \(CAS\)](#) is a research-performing institution and a science academy. The CAS is targeted towards the natural sciences and technology, and encompasses over 100 research institutes, a handful of universities and several national infrastruc-

tures (Key Labs and State Key Labs). Altogether, the CAS institutions employ some 40 000 researchers, and CAS is particularly important for Sino-Norwegian collaboration.

The [Chinese Academy of Social Sciences \(CASS\)](#) is a research-performing institution and a science academy. CASS is made up of 40 institutes in a variety of social science fields and collaborates with several Norwegian research institutions. CASS is often referred to as a think tank, and plays a special role as an advisor to the authorities on social and welfare policy reforms.

The [National Natural Science Foundation of China \(NSFC\)](#) is a research council funding basic research. The NSFC uses independent peer-review procedures and provides funding for research activities at both universities and institutes. In March 2018, the NSFC was put under the supervision of MOST. NSFC is an important partner for RCN.

Other important science academies are the Chinese Academy of Engineering (CAE) and the Chinese Academy of Agricultural Sciences (CAAS). Polar research is primarily administered and financed by the State Ocean Administration, which owns the Polar Research Institute of China (PRIC).

Innovation

China has an innovation ecosystem with competitive R&D funding schemes and tax incentives on a national level. Chinese provinces and cities have also established an impressive range of research parks, incubators and incentives. Most major international corporations are established with development activities in China. Many medium-sized European companies have also established a presence or invested in China.

Cooperation with industry

There are two types of Norwegian business sector groups (in addition to the research institutes) that have an interest in cooperation with China:

- > Companies with lengthy experience and well-established cooperative relationships with China. These companies can expand their involvement to include research collaboration. There is increasing recognition that both the volume and quality of Chinese research are growing rapidly, and it will be beneficial to be affiliated with China's expanding research infrastructure based on reciprocal knowledge sharing and recruitment.
- > Technology companies seeking entry into the large Chinese markets. Some of these companies have research as an integral part of their business strategy and will benefit from help to access networks, facilities and other advisory services

New Memorandum of Understanding from 2017

In 2017 the Research Council signed a Memorandum of Understanding with the National Natural Science Foundation of China (NSFC). That same year the Norwegian Ministry of Education and Research signed an [action plan](#) with the Chinese Ministry of Science and Technology (MOST).

The main objectives of the action plan are to:

- > strengthen industry-academic research collaboration;
- > promote knowledge and technology transfer between research organisations and industries;
- > improve the research and innovation capacities of both countries by making optimal use of existing resources

National instruments for research and education collaboration

The Research Council encourages Norwegian institutions to include international partners in all applications for funding.

The Ministry of Foreign Affairs (NOK 20 million annually) and the Ministry of Education and Research (NOK 10 million annually) are the most important funders of R&D collaboration with China. This funding is used along with other research funding for calls for proposals, preferably in cooperation with Chinese funding institutions, as NSFC and MOST.

The [INTPART](#) programme (International Partnerships for Excellent Education, Research and Innovation) is designed to facilitate partnership between Norwegian higher education and research institutions and excellent partners in priority countries with a special emphasis on integrating higher education and research. Partnerships may include business partners.

The Research Council and the SIU also collaborate through the [UTFORSK](#) Partnership Programme on establishing links between new educational components and existing research cooperation in China, and other priority countries.

The SIU, in cooperation with Innovation Norway, has developed the pilot initiative [Intern-Abroad](#) to support credit-yielding internships at companies in the BRICS countries, Japan, Canada and the US.

EU programmes for research and education collaboration

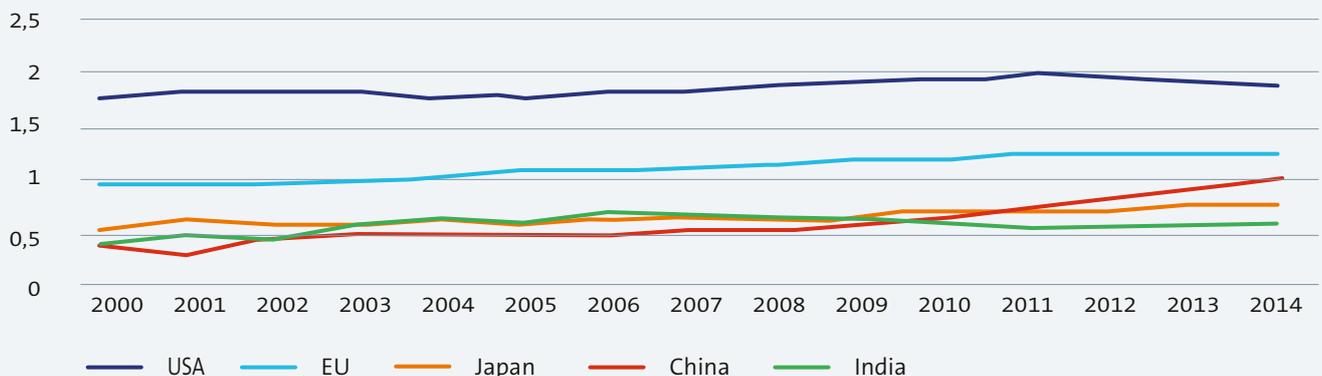
The EU has its own cooperation agreements and a [roadmap for research collaboration](#) with China. A number of thematic areas for cooperation on research and innovation with China have been specified, and these are closely aligned with the Norwegian priority areas for cooperation with China.

EU cooperation with China is based on funding from Horizon 2020 and China. The Research Council will continue to encourage Norwegian research institutions to take part in EU cooperation with China.

The [Erasmus+](#) International Dimension supports cooperation between Norway and China, offering opportunities for, among other things, student exchange, strategic partnerships, knowledge alliances and joint degrees.



S&E publication output in the top 1% of cited publications



The index measures the share of publications that are in the top 1% of the world's cited publications, relative to all the country's publications in that period and field.

Source(s): National Science Foundation, National Center for Science and Engineering Statistics; SRI International; Science-Metrix; Elsevier, Scopus abstract and citation database (<https://www.scopus.com/>), accessed July 2017.)

Thematic areas for research collaboration

Certain areas are particularly relevant as a basis for mobility and cooperation with China. These thematic areas are reflected in Norwegian and European agreements signed with Chinese authorities.

Sustainable urbanisation is a vital area for China due to the scale of its urbanisation challenges. China is working on a number of innovative solutions in this field. Norway can contribute to developing these solutions as well as benefit from them in the future. Norwegian institutions coordinate several Horizon 2020 projects in this area in cooperation with Chinese institutions.

Environment-friendly energy is one of the greatest global societal challenges. China faces challenges related to expanding its energy supply to meet the demands of economic growth and to distribution of electrical power. The main areas for industry-oriented research and innovation cooperation with China involve solar and offshore wind.

Carbon capture and storage (CCS) is an important measure for addressing climate challenges. China's emissions from fossil energy production are large, so there is a major potential for CCS to reduce the country's CO₂ emissions. Norway is a world leader in CCS technology and coordinates the ERA-Net co-fund ACT (Accelerating CCS Technologies).

Sustainable aquaculture is a highly relevant area, as both China and Norway are major marine and aquaculture nations. Both countries are also interested in management and development of the fisheries, aquaculture and seafood-processing industries. Sustainable seafood production and research on safe,

healthy seafood are natural areas of cooperation. China has major strengths in the areas of integrated multi-trophic aquaculture and algae cultivation.

Sustainable agriculture is given high priority in Norway and China alike. Sustainable agriculture is a strongpoint of Norway, and the Norwegian research community has established good networks and cooperation agreements with China. Relevant fields include food security, food safety and the bioeconomy.

Climate, the environment and the polar regions are areas where Norway seeks to take a global leadership role. To succeed in this, cooperation with China is essential. Cooperation within these areas is already well established. Increased collaboration on research related to Svalbard is encouraged.

Cooperation on infrastructure is important because China is investing heavily to expand and modernise its research infrastructure. Cooperation will mainly be carried out via participation in the European Strategy Forum on Research Infrastructures (ESFRI). Norway already collaborates with China on a radar system for scientific studies of the upper atmosphere, the Aurora Borealis, and for warning of space storms (EISCAT_3D).

Maritime activities are a vital part of Norwegian industry both domestically and in Asia. Cooperation is important because China is a

major shipping nation, a large shipbuilding nation, and a main actor in maritime research. The bulk of Norway's established business activity in China is comprised of the maritime cluster concentrated around Shanghai.

Digitalisation is a high-priority area in both China and Norway, and is suitable for industry involvement. Digitalisation is a global priority involving all sectors of society, and both countries are highly digitalised societies.

Health innovations are critical for addressing the health challenges of the future. There is great potential in new medicines, medical technology and eHealth, given demographic trends in both Norway and China. Norway already has good health-related data and high-quality health care services. Together with the other Nordic countries Norway is very well positioned to develop health innovations to meet the large global demand. This field is well suited for industry involvement.

The **social sciences and humanities** may be relevant in all the indicated thematic areas, perhaps most of all in urban development, digitalisation and health innovations. China has very strong research groups in the humanities. Social science and humanities perspectives are essential for promoting mutual understanding, and research cooperation between our two countries.

Co-authorship between Norway and China by thematic areas, 2003 – 2015 (number of articles)

