European Commission

Roadmap for EU - India S&T cooperation

1. INDIA AS A PARTNER OF THE EU

The EU is India's largest trading partner, accounting for 13.7% of India's overall trade, ahead of China (11%) and the United States (9.6%). India is the EU's ninth largest partner, with the value of EU exports of goods to India amounting to €37.8 billion in 2016. The total value of EU-India trade in goods stood at €77 billion in 2016. Major EU exports to India include engineering goods (37.3%), gems and jewellery (19%) and chemical and allied products (10.7%). The primary EU imports include textiles and clothing (19.8%), chemical and allied products (15%) and engineering goods (15%). [1]

EU-INDIA Summit

The 14th Summit between the European Union and India took place in New Delhi on 6 October 2017. The leaders reconfirmed their commitment to strengthen the India-EU Strategic Partnership based on shared principles and values of democracy, freedom, rule of law and respect for human rights and territorial integrity of States.

The summit was also the occasion to welcome the fresh impetus given to the EU-India cooperation in research and innovation at the 11th Joint Scientific and Technological Cooperation Committee (JSTCC) meeting in June 2017. The leaders agreed to scale-up cooperation under the renewed India-EU Science and Technology Cooperation Agreement in frontier areas of science and technology and in addressing current global challenges in particular in the areas of health, water and clean energy. They welcomed the agreement to launch a major joint flagship initiative of €30 million on water-related challenges reflecting the pressing need to cooperate on technological and scientific knowledge and management capacities to cope with increasing stress on water resources. Both sides agreed to work towards reciprocal opening of the EU Framework Programme for Research and Innovation 'Horizon 2020' and Indian programmes, and called for an intensified two-way mobility of researchers. To this extent, the two sides welcomed the conclusion of the Implementing Arrangement between the Science & Engineering Research Board (SERB) and the European Research Council (ERC). The leaders also agreed to work towards an enhanced cooperation on innovation and technology development aiming at actions strengthening cooperation between European and Indian industries and start-up ecosystems.[2]

EU-INDIA non-S&T cooperation agreements

The EU-India *Strategic Partnership* was created in 2004 to enable the partners to better address international issues in the context of ever-increasing globalisation. To underpin that *Strategic Partnership*, the 2016 Summit adopted the *India-EU agenda for action 2020* which defined common objectives and proposed a wide range of supporting activities in the areas of political, economic, sectorial and development cooperation.

[1] https://eeas.europa.eu/sites/eeas/files/eu-india_fact_sheet.pdf
[2] http://www.consilium.europa.eu/en/press/press-releases/2017/10/06-india-summit-statements

The EU and India have been negotiating an ambitious Free Trade Agreement since 2007, covering effective market access and investment. Substantial progress has been made, however further progress is needed in improved market access for some goods and services, government procurement, geographical indications and sustainable development. At the 2017 Summit, leaders noted the ongoing efforts of both sides to re-engage towards relaunching negotiations for an India-EU broad based trade and investment agreement (BTIA).

Political cooperation covers a wide range of international concerns such as security (non-proliferation/disarmament, counter-terrorism, counter-piracy, cyber-security), international political issues (in particular South Asian region, the EU neighbourhood and the Middle East), energy, environment, and climate change.

The EU and India have signed a series of joint declarations to enhance sectoral dialogues on areas aiming at finding common solutions to global challenges, notably on combating Climate Change and shifting to renewable energy, on sustainable urbanisation and the blue economy. An increased cooperation in research and innovation is included in the joint declarations.

Human rights are addressed in the annual *EU-India Human Rights Dialogue* held locally in India. The EU is the only partner with which India has a bilateral human rights dialogue.

EU-INDIA S&T cooperation agreements

Research and Innovation is one of the areas where EU-India collaboration has expanded significantly since 2001 when the first *Agreement on the Scientific and Technological Cooperation* was signed. It was renewed in 2007 and 2016 until 2020. In addition, the *Agreement between the European Atomic Energy Community (Euratom) and the Government of the Republic of India in the field of Fusion Energy Research* is in force since 2010. India and Euratom are also cooperating constructively within ITER, the *International Thermonuclear Experimental Reactor*. On fission, negotiations on the agreement between Euratom and India for R&D cooperation in the field of peaceful uses of nuclear energy are in the final stages and both parties work towards its rapid conclusion.

R&I landscape in India

India's R&I landscape is contrasted. On the one hand, the country has ramped up scientific production at an impressive rate. India has several world-class centres for science education, particularly the Indian Institutes of Technology. On the other hand, with only 200,000 full-time researchers and 17 patent applications per 1 million people, India has few scientists relative to its population size, and it produces relatively few patents. The expansion of the top layer of federal higher education institutions performing research continues. Since 2006, seven Indian Institutes of Science Education and Research (IISERs) have been established, with a mandate to perform frontier research in basic sciences. The group of the more engineering and applied sciences oriented Indian Institutes of Technology (IITs) was also expanded (from 16 in 2014 to 23 in 2016). The majority of R&D personnel, however, continues to be employed in public research institutions such as the Council of Scientific and Industrial Research (CSIR) or in the Department of Science and Technology (DST), the Department of Biotechnology (DBT), the Department of Atomic Energy (DAE), etc. Except for the IISERs, IITs, the Indian Institutes

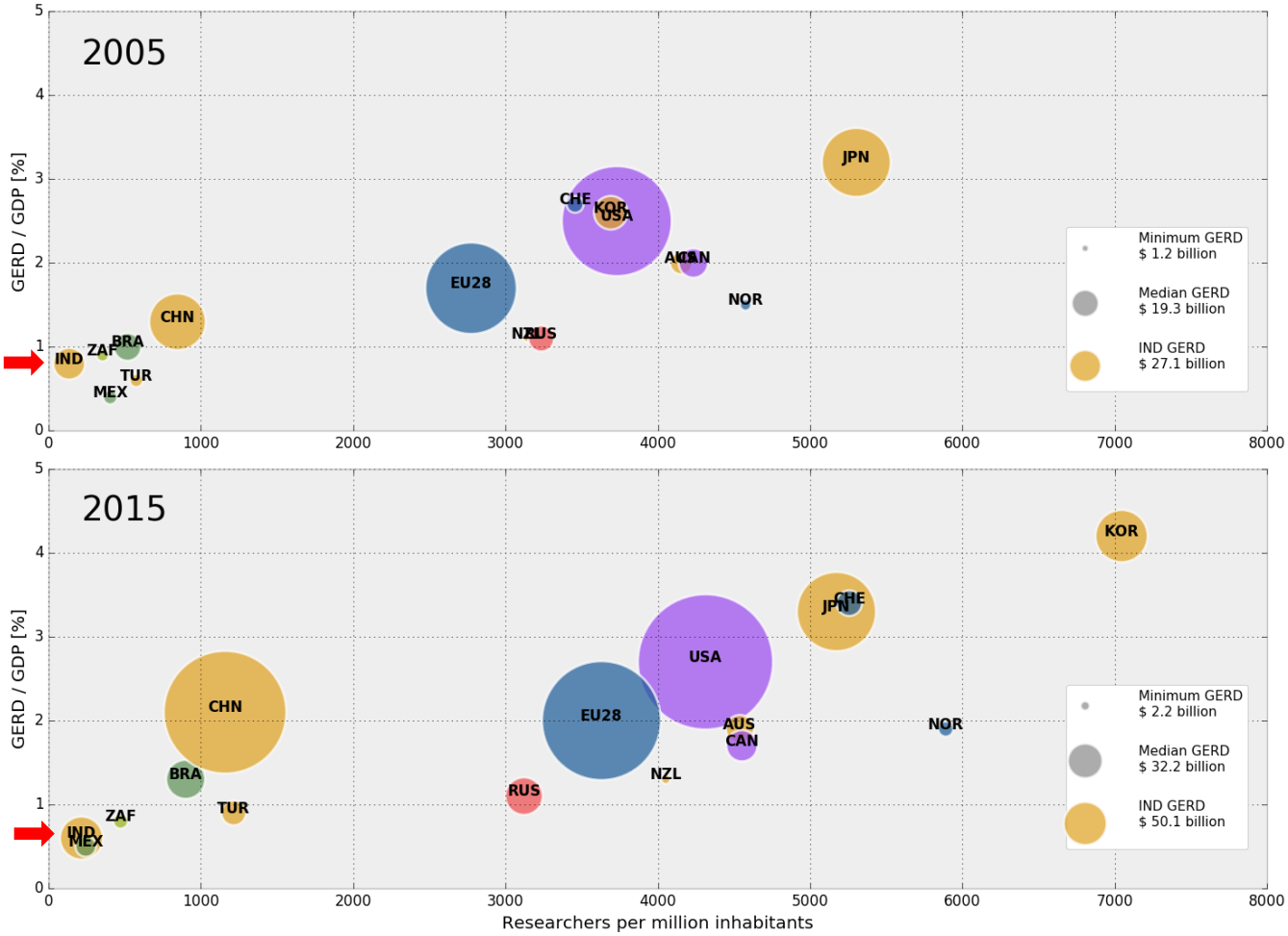
of Management (IIM), the All India Institutes of Medical Sciences (AIIMSs), the Indian Institute of Science, the Energy and Resources Institute (TERI), the Tata Institute of Fundamental Research and about 20 major central universities, the majority of the universities are focusing on teaching and are not engaged in research.

The outsourcing of knowledge-intensive activities to India has contributed to make the services sector the largest contributor to GDP (55%) and the presence of multinationals' R&D centres has accelerated India's integration in the global research system. India hosts several top corporate R&D investors in automotive, industrial machinery and IT industries.

The Indian technology start-ups landscape has seen a tremendous growth in the emergence of innovative start-ups and creative entrepreneurs. In terms of providing a conducive ecosystem for the start-ups to thrive, India has moved up to third position and has emerged as the fastest growing base of start-ups worldwide. India is one amongst the first five largest start-up communities in the world with a growing number of start-ups. Corporates have started investing in startups through an open innovation strategy. Foreign corporates based in India, which had so far their in-house R&D departments, are now scouting new innovative solutions among Indian startups.

In 2017, R&D expenditure, as percentage of its GDP, has been stagnant at 0.69 per cent and this for the third year. The lack of nominal increase in R&D investment is to be attributed to India's increase in GDP which rose at a faster pace in the last years compared to the other BRICS countries. Public expenditure is dominant with only a third of the Indian investment in R&D from the private sector. From the other two third of public spending, more than half of it relates to the defence, space and nuclear sectors.

Figure 1: Expenditures in Research & Development and researchers per million inhabitants



Note: GERD in current PPP; Top chart: Data for CHE from 2004. Bottom chart: Data on researchers per million inhabitants for BRA from 2014, for CAN from 2014, for MEX from 2013 and for AUS from 2010.
Source: DG RTD - International Cooperation
Data: UIS, OECD, EUROSTAT; extraction date: 11/10/2018

2. State of play of EU-INDIA S&T cooperation

2.1 FP7 and Horizon 2020 cooperation

In FP7 collaborative projects, there were 289 participations of entities from India. Indian participants, who were still funded under FP7, have received €39.14 million from the European Commission. Projects were funded in the fields of Energy, notably in wind energy, energy efficiency, synthetic and second-generation biofuels, coal mine methane drainage, and gasification of coal; Environment including climate change and water; Health; ICT; Nanoscience; Socio-economic research; and Food and agriculture.

Five coordinated calls were launched with India under FP7, resulting in more than 18 joint projects, with co-investments of about €30 million from each side in areas relating to Computational Material Science, Food and nutrition research, Solar Energy systems research, Partnering initiative on biomass and bio-waste, and Water related challenges.

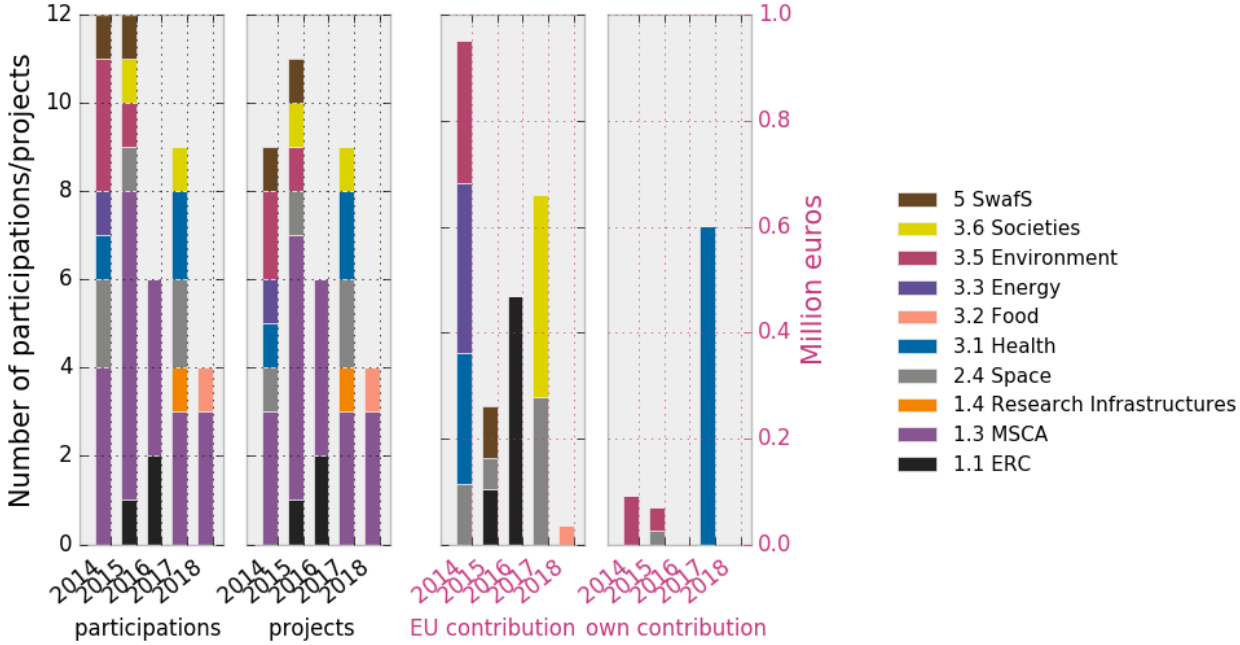
Several joint collaborative projects funded by MS funding agencies were also launched under the NEW INDIGO ERA-NET and its successor INNO INDIGO that was completed in April 2017.

Participation in Horizon 2020 (2014-2020), slowed down in the first years of the new framework programme but since 2016, the participation of Indian entities is increasing again. Indian entities have participated 98 times in 49 signed grants of collaborative, MSCA and ERC actions of Horizon 2020, receiving in total almost €4 million of direct EU contribution while the Government of India has co-funded the Indian beneficiaries for almost almost €15 million. Regarding collaborative actions (i.e. excluding projects under ERC, MSCA, SME Instrument and Access to Risk Finance) under Horizon 2020, Indian applicants are involved 547 times (3 times as coordinators) in 292 eligible proposals. Out of 152 high quality (above threshold) proposals, 21 were main listed, leading to a success rate of 13.8% (as compared to 15.8% overall for third countries).

A certain degree of collaboration between European and Indian Research Infrastructures has been going on throughout the years. India has become an associated member of CERN and is associated to a number of European Research Infrastructures, such as the Square Kilometre Array (SKA) radio telescope and the Facility for Antiproton and Ion Research (FAIR). India is also an active member of the Group of Senior Officials (GSO) on global Research Infrastructures (RI) in which context it has been seeking international partners for its underground laboratory (the India-based Neutrino Observatory – INO).

The Joint Research Centre (JRC) of the European Commission supports India through regional and multilateral initiatives, such as the Atlas of Regional Water Cooperation and Conflicts, and the Integrated Drought Management Programme (IDMP); JRC's Global Flood Awareness System is serving as an example of successful cooperation between Asia and Europe.

Figure 2: Participation of India in Horizon 2020



Note: Participations of beneficiaries, third-parties and partner-organisations.
Source: DG Research and Innovation - International Cooperation
Data: CORDA (JRC, EIT and art.185 not included); extraction date: 15/10/2018

2.2 Current framework conditions for EU-INDIA S&T cooperation

Framework conditions for cooperation in research and innovation between the EU and India are relatively satisfactory. However, the Indian patent regime should be strengthened; the complex legal framework simplified; and doing business made more transparent. R&I cooperation potential is also inhibited by procedural delays and capacity constraints in certain departments.

Mobility of researchers is promoted through the EU's *Marie Skłodowska-Curie* (MSCA) Research Fellowship Programme. India has a strong track record in the Marie Curie actions both under FP7 (2007-2013) and under Horizon 2020. In Horizon 2020, it is the second country in number of researchers funded by MSCA after China with 841researchers.

Regarding European Research Council (ERC) grants, 50 researchers of Indian nationality hold ERC grants (Indians are the fourth in terms of non-European nationality of grantees, after nationals of the USA, Canada and Russia.) In addition, an estimated 1 300 Indians are taking part as ERC team members (third biggest in terms of non-European nationality in ERC teams, after nationals of China and the USA). An implementing Arrangement between the ERC and the Science and Engineering Research Board (SERB) has been signed that will enable SERB Fellows/Grantees to pursue collaborations with ERC grantees conducting frontier research across Europe.

3. Priorities for future S&T cooperation

3.1 Areas of future S&T cooperation agreed at latest Joint Committee/High Level Dialogues

At the 2017 *EU-India Joint Steering Committee* meeting the two sides agreed to extend their cooperation to the following areas: Energy, in particular renewables and smart grids capacity in the framework of Mission Innovation; Nanotechnology, advanced materials and biotechnology; Health (vaccines, chronic diseases; mental health); Bio-economy and Agri-food; ICT, in particular Cyber-Physical-Systems (ICPS); Polar Sciences; and Green transport.

In addition, both sides agreed to launch a flagship initiative in the order of €30 million (each side €15 million) in the area of Water, notably on drinking water purification; wastewater management and monitoring control distribution and treatment systems. The call for proposals closed on 27 February 2018 and resulted in 55 submissions and five selected projects. All projects will start in February 2019.

EU and India cooperate well in the frame of the multi-lateral initiative on chronic diseases, in particular with GACD, the *Global Alliance for Chronic Diseases*. Since the EU joined GACD (India was already a member), calls have been launched on areas such as diabetes type 2, mental health, lung diseases and hypertension. Cooperation will continue in the future on different chronic diseases. Furthermore, multilateral international cooperation in the field of regulatory science - technologies for global healthcare could be of interest as well.

On fusion cooperation, both sides agreed at the second *Euratom-India Coordinating Committee* meeting (CC-2), to share knowledge and understanding of the respective fusion programmes and strategic roadmaps, ITER constituting the main benchmark for both Parties. The Mapping of bilateral collaborative activities that covers all collaborations between European and Indian labs is a rolling action. In October 2018, 12 active collaborations involving six European and two Indian laboratories were counted. The last Euratom-India Coordinating Committee meeting (CC-4) was held on 22.10.2018 in Gandhinagar, India in the margins of the 27th IAEA Fusion Energy Conference (FEC-2018) that was hosted for the first time in India.

Cooperation on Green Transport is reflected in the Horizon 2020 WP 2018-2020, where India is a targeted country in two calls "LC-GV-05-2019: Urban mobility and sustainable electrification in large urban areas in developing and emerging economies" and "LC-MG-1-1-2018: InCo flagship on reduction of transport impact on air quality". In addition, India is encouraged to participate in the call topic "LC-MG-1-3-2018: Harnessing and understanding the impacts of changes in urban mobility on policy making by city-led innovation for sustainable urban mobility".

3.2 Potential new areas of future S&T cooperation proposed at latest Joint Committee/High Level Dialogue, through SFIC, or by thematic services

The EU encouraged Indian participation in health research within multi-lateral platforms such as the *Global Research Collaboration for Infectious Diseases Preparedness* (GloPID-R)[3] and the *International Initiative for Traumatic Brain Injury*[4]. In July 2017, the *Department of Biotechnology* (DBT) has committed to cooperate on anti-microbial resistance and it is one of the members of the *Joint Programming Initiative* on Anti-Microbial Resistance (JPI AMR)[5], while the Indian Council of Medical Research (ICMR) has become a Member of GloPID-R. In line with the EU-India commitment at the Summit in 2017, the EC and the Department of Biotechnology (DBT) launched a flagship call on influenza vaccine development (Horizon 2020 Work Programme 2019 (SC1-BHC-32-2019) in the order of €30 million (each side earmarking €15 million). Participation of at least three Indian entities per proposal is mandatory.

On the Bioeconomy area, India has become a member of the International Bioeconomy Forum, a multilateral platform for discussion and action on the bioeconomy established in 2016.

In the energy sector, India participates in a few Technology Collaboration Programmes (TCP) of the International Energy Agency (IEA), which it joined in 2017 as Association Country. India has also been increasing its engagement with the Mission Innovation initiative, co-leading the Analysis and Joint Research subgroup and three Innovation Challenges (Smart Grids, Off-grid Access to Electricity, and Sustainable Biofuels). These two platforms could facilitate greater R&I collaboration with the EU through joint projects in low-carbon energy technologies. For example, India is a region where there are significant prospects for Concentrated Solar Power (CSP). Deployment and research cooperation activities can target specific applications, for example small-size CSP installations for rural areas.

In the field of ICT, DST expressed interest in supporting research, which is in line with the national agenda on digital India in areas such as combating cybercrime, as well as on energy, in context of Mission Innovation, notably on Smart Grids and energy storage capacity.

3.4 Improvements in framework conditions agreed at latest Joint Committee/High Level Dialogue and additional framework conditions to be addressed at future policy dialogue meetings

To support the participation of entities established in India in Horizon 2020 collaborative projects for the period of 2018-2020, a co-funding mechanism has been agreed with the Department of Biotechnology (DBT) covering all areas related to biotechnology: Health, Agriculture, Food Security, Bio-economy and Bioenergy; with the Department of Science and Technology (DST) covering all areas of Indian strategic interest across Horizon 2020; and with the Ministry of Earth Science (MoES) for a limited number of calls of their areas of responsibility.

Discussion with Indian authorities will be pursued to improve framework conditions for innovation, to promote the opening of Indian R&I programmes to EU researchers, and to simplify administrative procedures.

[3] http://www.glopid-r.org
[4] http://intbir.nih.gov/
[5] http://www.jpiamr.eu

To enhance cooperation in innovation, the EU-India incubators and accelerators network was launched in October 2018 in Bangalore. This pilot initiative aims at matchmaking cohorts (2x20) of incubators and accelerators from India and the EU and foster cooperation between them such as exchange of startups, staff, mentoring, or best practices to facilitate internationalisation of startups. This pilot initiative is a first step in the EU-India cooperation in innovation.[6]

[6] https://startupeuropeindia.net/eiip/

ANNEX: UPCOMING HORIZON 2020 WORK PROGRAMME 2018-19 TOPICS EXPLICITLY ENCOURAGING COOPERATION WITH INDIA

	Topic identifier	Topic title
2019	INFRAIA-01-2018-2019	Integrating Activities for Advanced Communities
	SC1-BHC-32-2019	Towards a next generation influenza vaccine to protect citizens worldwide – an EU-India collaboration
	LC-CLA-07-2019	The changing cryosphere: uncertainties, risks and opportunities
	LC-GV-05-2019	InCo flagship on "Urban mobility and sustainable electrification in large urban areas in developing and emerging economies"
	LC-SC3-NZE-5-2019-2020	Low carbon industrial production using CCUS
	SU-SPACE-22-SEC-2019	Space Weather
	DT-SPACE-06-EO-2019	International Cooperation Copernicus – Designing EO downstream applications with international partners

Figure 3: India – Top scientific areas compared to EU28 in terms of citation impact of publications

	Scientific Area	Share in world output	Share of international co-publications	Citation Impact Difference with EU28	8-year trend
High publication output	Materials Science: Metals and Alloys	3,9%	23%	+0.16	↑
	Physics and Astronomy: Instrumentation	4,1%	23%	0.0	↑
	Biochemistry, Genetics and Molecular Biology: Biophysics	3,7%	22%	-0.07	↑
	Environmental Science: Waste Management and Disposal	5,1%	19%	-0.1	↓
	Materials Science: Materials Chemistry	5,4%	23%	-0.12	↑
	Materials Science: Surfaces, Coatings and Films	5,3%	21%	-0.15	–
	Chemistry: Spectroscopy	7,8%	20%	-0.15	↑
	Physics and Astronomy: Nuclear and High Energy Physics	4,7%	44%	-0.16	↑
	Materials Science: Ceramics and Composites	4,5%	22%	-0.21	↑
	Chemistry: Organic Chemistry	8,6%	16%	-0.22	–
Low publication output	Nursing: Advanced and Specialized Nursing	0,5%	49%	+0.56	–
	Materials Science: Miscellaneous	4,9%	9%	+0.46	↑
	Earth and Planetary Sciences: Paleontology	1,6%	48%	+0.3	↑
	Biochemistry, Genetics and Molecular Biology: Miscellaneous	21,0%	7%	+0.3	–
	Business, Management & Accounting: Tourism, Leisure & Hospitality Management	0,9%	23%	+0.28	–
	Mathematics: Numerical Analysis	3,4%	29%	+0.17	↑
	Mathematics: Geometry and Topology	2,6%	43%	+0.13	↑
	Dentistry: Orthodontics	2,4%	18%	+0.1	–
	Physics and Astronomy: Acoustics and Ultrasonics	1,6%	20%	+0.07	↑
	Nursing: Community and Home Care	1,8%	29%	+0.06	–

Source: DG Research and Innovation – International Cooperation
Data: Elsevier SciVal; extraction date: 6/8/2017; publications' window: 2011-2013; citations' window: 3 years
Note: These tables show scientific areas in which the country's academic publications have a higher citation impact than EU28, and whether this difference has decreased, increased or remained the same in the past 8 years. They are grouped in two tables. The top table focuses on areas with high share of publications in the country's total output of publications and the bottom table on those with low share of publications. Scientific areas are based on Elsevier 'All Science Journal Classification'. For each area, the country's share in the world output of publications and the share of international co-publications are also shown.

Figure 4: India – Specialisation compared to EU28 in selected technologies based on PCT patents

	Technology	2014 PCT patents	2014 PCT patents of EU28	2014 Specialisation compared to EU28	8-year trend
OECD classification	Pharmaceuticals	360	2.524	3,67	↑
	Nanotechnology	11	137	2,07	↑
	ICT	718	14.579	1,27	↑
	Biotechnology	112	2.745	1,05	↓
	Selected environment-related technologies	98	3.663	0,69	↑
	Medical technology	100	3.879	0,66	↑
WIPO classification	Pharmaceuticals	238	1.581	5,55	↑
	Organic fine chemistry	222	1.595	5,14	↓
	IT methods for management	54	425	4,69	↑
	Biotechnology	59	1.400	1,56	↓
	Macromolecular chemistry, polymers	35	870	1,48	↑
	Computer technology	64	1.762	1,34	↑
	Micro-structural and nano-technology	3	86	1,29	–
	Food chemistry	14	484	1,07	↓
	Analysis of biological materials	12	426	1,04	↑
	Chemical engineering	37	1.315	1,04	↑
	Materials, metallurgy	24	939	0,94	↑
	Medical technology	70	2.801	0,92	↑
	Thermal processes and apparatus	19	791	0,89	↑

Source: DG Research and Innovation – International Cooperation
Data: OECD (top table) WIPO (bottom table); extraction date: 6/8/2017
Note: The top table shows the relative specialisation of the 2014 PCT patent output of the country with respect to EU28, calculated as (# of patents of country in technology X / # of patents of country in all technologies) / (# of patents of EU28 in technology X / # of patents of EU28 in all technologies). It also shows whether the relative specialisation has increased, decreased or remained the same in the past 8 years. The selected technologies are classified based on the OECD database. The bottom table shows the same information for the top-13 technologies with the highest specialisation index with respect to EU28 - this time the technology classification is based on the WIPO database. Both tables also show the country's and EU28 total number of PCT patents under each technology in 2014.