

РОССИЙСКО-ИНДИЙСКИЕ НАУЧНЫЕ СВЯЗИ

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Looking back: India-Russia collaboration in Science and Technology

1. Introduction

Developed economies in the 21st century are knowledge utilizing economies. Emulating them countries across the globe are expanding their scientific and technological capabilities to create, access and disburse knowledge in order to develop and become wealthy. Improvements in the standard of living of the general populace are a secondary by-product of the economic development process. Knowledge is an important factor in the economic development activity. Knowledge generation by itself is a formidable uphill task, and its

benefits are capricious. At times new knowledge brings in immediate windfall rewards and at times the ideas and technologies created have to wait decades for complimentary innovations and suitable commercial environments to be born. Acquisition of existing knowledge and its subsequent adaption is an easier exercise; its rewards, albeit not so windfall, are more sure-footed. One has the 'late comer' advantage, one can opportunistically choose ideas and technologies that have proved their viability and leave out the current 'no starters'. Secondly one can learn the pitfalls of the adaption road from the topples and accidents of the carts that have journeyed ahead. To paraphrase Peter Thiel the climb from 0 to 1 (doing new things) is vertical progress exemplified by Silicon Valley, whereas the journey from 1 to n (copying things that work) is horizontal progress explified by what China has been doing over the past three decades [Peter Theil, 2014].

Despite this huge disimilarity in orientations, the smartest and most developed countries feel the need to collaborate globally, as much as backward countries yearn for the import of viable knowledge and technology from its advanced cradles. The urge to collaborate is not altruistic in any sense of the word. All countries seek cross-border collaborations in science and technology because the collaboration excercises beget fresh/bright brains to work on their domestic research agendas, or because technology transfer brings in profits and helps create markets in backward regions, or in order to make inroads into existing markets, or in order to strenghten national geo-political standing through science diplomacy, or for deeper and less obvious reasons. Secondly collaboration in science and technology is not an invention of the modern world. The university at Takshila or library at Alexandria gained fame because they were global centers of learning.

Likewise, collaboration in science and technology (S&T) between India and Russia is not a child of what is fashionably called *globalization* (a broad term used to signify post cold-war expansion in international trade and foreign investment). Indo-Russian collaboration in S&T preceeds the fall of the Berlin Wall and even the cold-war itself. It even preceeds the birth of India as an independent country. The foot-notes of history recount stories of Indian scientists and activists visiting Soviet Russia as early as the 1920's.

This paper makes an attempt to chalk and review the collaboration in science and technology between India and Russia, as it evolved over years. It does not treat the S&T endeavour as an activity carried out by some single-focus acid-stained scientists working in cloistered laboratories. On the contrary it treats the S&T endeavour as a reigned horse, among the many horses, of the larger geo-political context. It therefore begins with a review of the larger geo-political relationship between Russia and India before it gets down to chalking the birth and development of specific S&T collaboration mechanisms between the two countries. It then concludes with an attempt to measure and judge the cooperation.

2. Indo-Russia Relations

Despite the interest of many Indians in the achievements of the Soviet Union, relations between the two countries did not take any credible shape during the Stalin era because India was not an independent country before 1947 and in the half-decade till Stalin's death in 1953, Moscow viewed Nehru's India as a weakling in the broad worldwide anti-colonial struggle and at times as a stooge of US imperialism. The situation started changing with the

consolidation of power by Nikita Khrushchev, who was softer in his opposition to capitalism and imperialism. Indo-Soviet bonhomie started with Jawaharlal Nehru's visit to the USSR in June 1955 and the Khrushchev/Bulganin visit to India in December 1955 [<http://countrystudies.us/india/133.htm>, accessed 30/07/2015]. After the 20th Congress of the CPSU in February 1956, a mellowed down Soviet Union started acting on Khrushchev's three peaceful – peaceful co-existence, peaceful competition and peaceful transition. During this period, the USSR began using the instruments of aid, trade and diplomacy to limit Western influence in developing countries. Subsequently, Indo-Soviet relations flourished over the decades in the metallurgy, defence, energy and trade sectors [Scott. D 2011].

The Soviet Union and some East European countries offered India new avenues of trade and economic assistance. By 1965 the Soviet Union was the second largest national contributor to India's development. These new arrangements contributed to India's emergence as a significant industrial power through the construction of plants to produce steel, heavy machinery and equipment, machine tools, precision instruments, and to generate power and extract and refine petroleum.

In the early 1970s both Indian and Soviet leaders looked on the emerging US-Chinese relations as a serious threat to their security. This led to a most intimate phase in relations between India and the Soviet Union. It was the period between 1971 and 1976: its highlight being the twenty-year Treaty of Peace, Friendship, and Cooperation of August 1971. It marked important milestones in relations between two countries and provided a legal and political basis for strengthening of Indo-Soviet cooperation in the political, cultural, and technical & scientific spheres.

Rajiv Gandhi journeyed to the Soviet Union in 1985, 1986, 1987, and 1989, and Soviet President Mikhail S. Gorbachev travelled to India in 1986 and 1988. These visits and those of other high officials evoked effusive references to the "exemplary" (in Gorbachev's term) friendship between the two countries and also achieved the conclusion of agreements to expand economic, cultural, and scientific and technological cooperation. In 1985 and 1986, and again in 1988, both nations signed pacts to boost bilateral trade and provide Soviet investment and technical assistance for Indian industrial, telecommunications, and transportation projects. Protocols for scientific cooperation, signed in 1985 and 1987, provided the framework for joint research and projects in space science and other high-technology areas such as biotechnology, computers, and lasers.

Indo-Russia bilateral relations helped India build noticeable scientific capacity for achieving sustainable economic growth and contribute to tackling global challenges. During the cold-war period India and the Soviet Union enjoyed a strong strategic, military, economic and diplomatic relationship. After the collapse of the USSR, Russia inherited the close relationship with India, even as India improved its relations with the west after the end of the Cold War. Traditionally, the Indo-Russian strategic relationship was built on major components: Trade, Economic, Scientific, Technological and Cultural Co-operation and Military Technical Co-operation [P. Stobdan, 2010]. Today this relationship is governed by Indo-Russian Inter-Governmental Commission (IRIGC) which is the main body that conducts affairs at the governmental level between both countries. It is divided into two parts, the first covering Indo-Russian Inter-Governmental Commission on Trade, Economic, Scientific, Technological and Cultural Co-operation (IRIGC-TECH). This is normally co-chaired by the Russian Deputy Prime Minister and the Indian External Affairs Minister. The second part of the commission covers Military Technical Co-operation. It is co-chaired by the respective Defence Ministers belonging to both countries. Both parts of the IRIGC meet

annually. The Commission covers 11 joint working-groups, namely: trade and economic co-operation; pharmaceuticals; petroleum; coal; metallurgy; science and technology; cultural cooperation; information technology; power and energy; the environment and natural resources; and co-operation with the regions [Minch. I. Mallikarjun., 2014].

Despite the disintegration of the Soviet Union in 1991, the relationship between India and Russia remained one of the considerable importances to both countries. When the Soviet Union disintegrated, bilateral relations in the early 1990s went through a period of uncertainty when Russia was preoccupied with domestic economic and political issues, and in redefining its relations with the USA and Europe. During the same period India also initiated a series of structural reforms which sought to transform its semi-command economy into a open-market economy. Despite changes in democratically elected political parties/coalitions that have governed New Delhi ever since, this transformation has continued unabated although its pace and emphasis has varied. Likewise Moscow has also continued the *Prestorika* that President Gorbachev initiated in the 80's. The similarity in paths (political stability accompanied by step-by-step gradual deregulation of the economy) and the commonality in destinations (open market capitalism) laid the basis for a fresh friendship which could invoke the heritage of the past. After an initial lull in the relationship in the early 90's political leaders in both countries sought opportunities to reach out to each other.

1993 onwards, New Delhi and Moscow worked to redefine their relationship according to post-Cold War realities. During the January 1993 visit of Russian president Boris Yeltsin to India, the two countries signed agreements that signaled a new emphasis on economic cooperation in bilateral relations. The 1971 treaty was replaced with the new Treaty of Friendship and Cooperation, which dropped security clauses that in the Cold War were directed against the United States and China. Bilateral relations between India and Russia improved as a result of eight agreements signed in December 1994. The agreements cover military and technical cooperation from 1995 to 2000, merchant shipping, and promotion and mutual protection of investments, trade, and outer space cooperation.

A major milestone in the post cold-war bilateral relationship was the formal "Declaration on Strategic Partnership between the Republic of India and the Russian Federation", signed during Putin's visit to India in October 2000. Broadly, this agreement meant enhanced co-operation in the political, economic, defence and cultural fields. It talked of 'deepening and diversifying cooperation in sectors such as metallurgy, fuel and energy, information technology, communications and transport, including merchant shipping and civil aviation', and of 'further development of cooperation in banking and finance, and improving credit and insurance facilities'.

In spite of the advance in the Indo-Russian relationship from its 1993 level, it has not attained the intensity that existed during the early 1970's. The US-China axis that propelled the relationship in the 70's is non-existent today. On the contrary China's economic growth and consequent increasing political and military strength makes Washington uneasy by the day. On the other hand the post cold-war realpolitik makes Russia look west for friends and partners. Likewise India finds itself ridding a similar wagon where many strong nations, including China and the USA, want strategic relationships with New Delhi. This context – changed scenario – should not be missed when reviewing the Indo-Russian science technology collaboration.

3. Indo Russia Science and Technology Co-operation

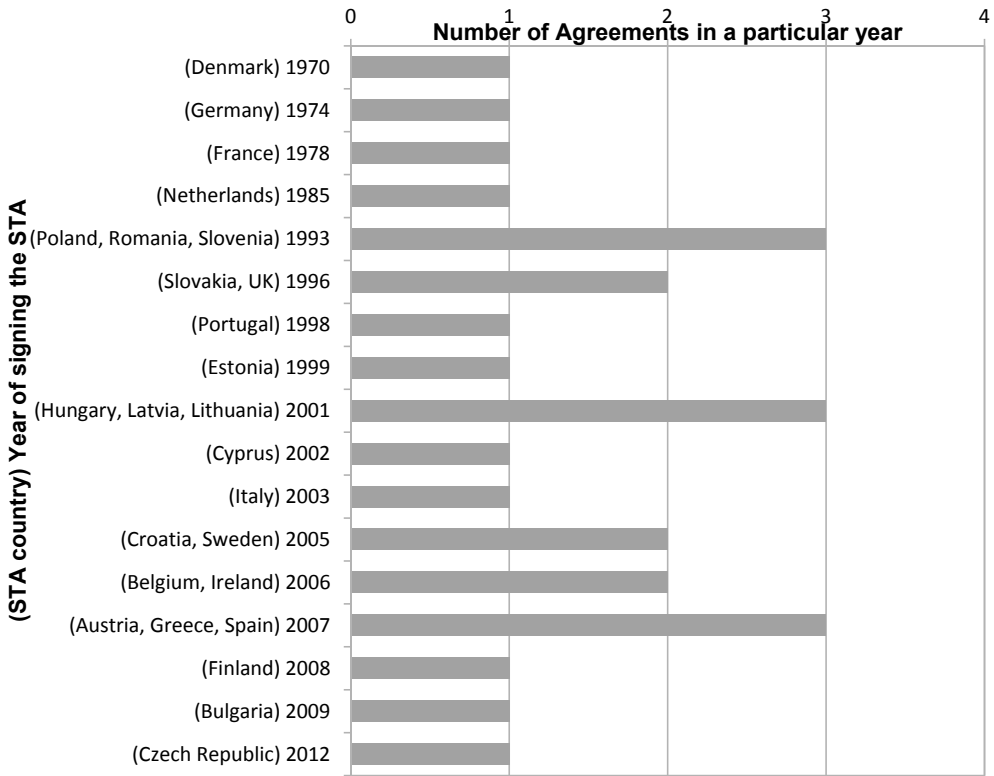


Fig 1: Science Technology Agreements (STA) between India and European countries

Fig. 1 represents a mapping of the year in which an European country inked a Science Technology Agreement (STA) with India which subsequently went on to define the broad framework in which its Sciences and Technology (S&T) cooperation with India has been taking place till date. It in no way represents the beginning of the S&T cooperation, which in certain cases started decades earlier. Nor does it take stock of any earlier framework agreements (such as those of certain Warsaw pact countries with India); it merely represents the inception of the latest. The illustration clearly indicates that the bulk of the present institutionalized forms evolved after India started shifting from the semi-command economy mode to the open market mode.

India expanded its international collaboration by adopting bilateral, regional and multilateral cooperation. Presently India has bilateral S&T cooperation agreements with 83 countries, which involves active cooperation with 44 countries. During recent years the cooperation has strengthened significantly with Australia, Canada, EU, France, Germany, Israel, Japan, Russia, UK and USA [DST, 2014]. India has adopted three complementary models for leveraging ‘collaborative advantage’ in shaping its S&T engagement with other countries during the last few years. They are a) Technology Diplomacy; b) Technology Synergy; and c) Technology Acquisition.

The collaborations in selected areas of mutual interest with different countries/organisations get materialized through various modes of cooperation like: (a) Contact Building through: Joint workshop, Fellowship & Internship etc; (b) Provide Support for: Joint R&D Projects of mutual interest, access to advanced Facilities etc; (c) Facilitate and Promote: Joint R&D clusters, Virtual Networked Centres etc; (d) Promote Commercial R&D and Innovation: Facilitate Technology Development & Tech Transfer, Academia — Industry Applied R&D Projects [DST, 2014].

As mentioned earlier India has strategic ties with Russia since long and informal contacts between Russian and Indian scientists started as early as 1920s. However, it was only in 1960, that a formal agreement on the Cultural, Scientific and Technological Cooperation was signed. It shifted the focus of cooperation between the two countries from the ordinary exchanges of scientists to formulation of joint projects in selected areas. On 9 August 1971, the historical “Treaty of Peace, Friendship and Cooperation” was signed, which laid a strong foundation for cooperation between the two countries in the areas of economy, science, technology and culture. As a follow-up of this Treaty, an Inter Governmental Soviet-India Joint Commission on Economic, Trade, Scientific and Technical Cooperation was set-up in 1972. A Joint Working Group on Science and Technology, set up subsequently, coordinated all the activities in this area.

Initially the Science & Technology Cooperation was pursued under the Science & Technology agreement between India and Soviet Union. Direct interaction between scientists and scientific institutes received a major boost when the Integrated Long Term Programme (ILTP) of Cooperation in science and technology (ILTP) was launched at the highest level by the then Prime Minister of India, Rajiv Gandhi and by Mr. Mikhail Gorbachev, the then President of the erstwhile Soviet Union in 1987. ILTP was the largest bilateral Science & Technology program that India had ever entered into with any country. The ILTP is coordinated by the Department of Science & Technology on the Indian side and by the Russian Academy of Sciences on the Russian side.

Within the framework of ILTP, from 1984 to 1989, the two countries jointly developed 112 themes in 22 priority scientific areas, including solar energy use, anticorrosion metal protection, power metallurgy, foamed metals manufacture, high pressure physics, meteorology and oceanography [P. Stobdan, 2010]. Considering the benefit which accrued from the programme and the untapped vast potential it was agreed by the two sides to extend the programme by another decade with a focus on technology transfer. This cooperation was strengthened further when the visiting Russian President Vladimir Putin and the Indian Prime Minister A. B. Vajpayee signed the ‘Declaration on Strategic Partnership between India and Russia’ on 3 October 2000 at New Delhi. The agreement provided an extension to ILTP up to 2010. In the meanwhile, the Joint Working Group for Cooperation in Science & Technology which was set up in 1993 initially in areas of building materials, meteorology, oceanography, standardization, certification and metrology, and agricultural research, later extended its ambit to medical sciences, biotechnology, and industrial realization of high technologies. Department of Science and Technology (DST) has also facilitated an institution level mechanism for fostering exchange of knowledge and scientists through the Indian National Science Academy (INSA,) which is one of India’s premier scientific professional bodies. In 2001, INSA joined hands with Russian Academy of Sciences for Inter-Academy Exchange Programme [n.rbth.com/economics/2013/03/12/science_and_technology_cooperation_to_grow_between_india_and_russia_22837.html]. In 2007, Department of Science (DST) and Technology and Russian Foundation for Basic Research (RFBR) had

again extended the cooperation agreement and thereafter in 2010 Russian-Indian Scientific & Technological Centre was established under the prime ministership of Manmohan Singh and Russian Federation President Vladimir V. Putin to facilitate and channelize commercial/industrial applications of new jointly developed technologies. The 12th annual summit adopted a Joint Statement titled 'Furthering the India Russia Strategic Partnership to meet the Challenges of a Changing World'.

To strengthen S&T cooperation at federal level a Memorandum of Cooperation in Science, Technology and Innovation between Ministry of Science & Technology, GOI and the Ministry of Education and Science (RMES) of Russia was signed on Dec 24, 2012 during the Summit meeting at New Delhi. The Memorandum provides for implementation of cooperation through joint programs or projects facilitating social and economic developments of the two countries through separate cooperation arrangements between RMES and Indian agencies.

Thus the present cooperation between India and Russia is being implemented through following institutionalised bilateral level programmes and mechanisms listed below:

- A. Integrated Long Term Programme (ILTP) of Cooperation in Science & Technology
- B. Indo-Russian Working Group for Cooperation in Science & Technology
- C. Inter-Academy Exchange Programme
- D. Basic Science Cooperation Programme
- E. Indo-Russian S&T Centre for two-way Technology transfer and Commercialization (IRSTC)
- F. Inter-Ministerial Science, Technology and Innovation Cooperation

A. Integrated Long Term Programme (ILTP) of Cooperation in Science & Technology:

The programme facilitates bilateral cooperation between the scientific communities of two countries by way of joint research projects, bilateral workshops/seminar, focused exploratory visits of scientists, visit of thematic scientific and composite (scientific and industrial) delegations in the identified priority area of basic (Mathematics, Theoretical and Applied Mechanics, Earth Sciences, Physics & Astrophysics, Ecology and Environment, Chemical Sciences, and Life Sciences) and applied (Biotechnology and Immunology, Material Science and Technology, Laser Science & Technology, Catalysis, Space Science & Technology, Accelerators and their Application, Hydrology, Computers & Electronics, Biomedical Science & Technology, Oceanology and Oceanic Resources, Engineering Sciences) sciences.

The ILTP completed 20 years in 2007. The program resulted in development of new knowledge, products, processes, designs and facilities and setting up of eight Joint Centres of excellence to pursue the concerted areas where large interactive research work progresses, details of which are in Table. Over 500 joint projects were sanctioned, 110 joint workshops were conducted / seminars, over 3500 exchange visits of scientific personnel took place in the programme. More than 1500 joint publications in international journals were published and 10,000 stable scientific contacts were established [<http://www.indianembassy.ru/index.php/science-technology/indo-russian-s-t-cooperation>]. Today, more than 70 institutions in Russia and 55 institutes and laboratories in India have participated in the programme, which are evident in the tables.

The ILTP between India and Russia was therefore extended for another 10 years in 2010 with a renewed mandate “innovation led technology programme”. Additionally, ILTP Fellowships are also provided to the young and experienced Russian researchers to work in Indian laboratories and industrial units.

Centres of excellence	Year	Place	Thrust Area
Advanced Research Centre for Powder Metallurgy and New Materials	1980	Hyderabad	Surface Engineering, Ceramics, Powder Metallurgy and Laser Processing of materials
Polio & other Vaccine Manufacturing Facility	1987	Bulandshahar	polio vaccine production
Indo-Russian Centre for Advanced Computing Research	2000	Moscow	Computational Fluid Dynamics, Seismic Data Processing and Development of Parallel Compiler
Indo-Russian Centre for Biotechnology	2001	Allahabad	Biotechnology incubator to promote technology transfer and commercialisation
Indo-Russian Centre for Gas Hydrates Studies	2003	Chennai	For the exploration activity for gas hydrates in India
Indo-Russian Centre for Earthquake Research	2003	New Delhi	Aimed at pre-cursor studies, simulations, disaster mitigation and developing techno-morphic maps of the high seismic regions
Russian Indian Centre on Ayurvedic Research	2004	Moscow	Process and formulation of Ayurvedic drugs
Indo-Russian Centre for Biomedical Technology	2008	Thiruvananthapuram	Biomedical Equipment

Commercial and Industrial adaption of fundamental and applied research and development findings through new generation equipment systems, material and high-tech products has now become priority for ILTP implementation. Listed below are some major areas of ILTP where Russia is helping India bring home the latest technologies:

Area	Activity
Medicine	Production of Vaccine against Poliomyelitis; in development of immune modulators; joint research in immunology, epidemiology, biophysics, oncology, endocrinology and cardiology
Materials	Powder Metallurgy centre is set up for producing powder substances;
Electronic Materials	A centre for the production of Industrial electron accelerators has been opened in Mumbai; Modern radio chemical research centre will be built in Indore
Information technologies	With the help of network of powerful parallel computers such as PARAM-10.000 (developed by Pune based Centre of Advanced Computer system) to develop short term weather forecasting programme, a programme modelling interaction of the atmosphere and the ocean reflecting monsoon circulation and processing seismic data,
Biotechnologies	Technology for zinc bacterial extraction from minning waste; Joint research is underway to obtain a vaccine against Hepatitis C; to create agricultural crops resistant to fungus infection

Silicone	Project of large scale production of semi conducting silicone for microelectronics, power electronics and solar energy application; Development of porous silicon luminescent devices and detectors
Aircraft	Design of Light Transport Aircraft (LTA) "SARAS-DUET"
Space Exploration	Low Energy Gamma Ray Experimental Payload by TIFR, Bombay which will be launched on-board Russian Sun-pointing satellite photon.
Seismic Instrument Making	Integration of Russian seismic sensors with Indian digital recorders and stationing them at various IMD sites for field observations.
Industrial accelerator	Development of 10 MeV Linear Accelerator (LINAC) for industrial radiation application.

ILTP Research Area Co-ordinator In India and Russia

Area	India	Russia
Biotechnology & Immunology	University of Delhi	RAS
Material Science & Technology	NPL	Institute of Inorganic Chemistry, Novosibirsk
Laser Science & Technology	Centre of Advanced Technology, Indore	Institute of Laser Physics, Moscow
Catalysis	National Chemical laboratory, Pune	United Institute of Catalysis
Accelerators and their applications	Centre for Advanced Technology, Indore	Budker Institute of Nuclear Physics Novosibirsk
Hydrology	National Institute of Hydrology, Roorkee	Water Problem Institute, Moscow
Computers & Electronics	Department of Information Technology	Institute of Computer Aided design, Moscow
Bio Medical Science and Technology	DRDO	RAS, Moscow
Oceanology & Oceanic Resources	Ministry Of Earth Sciences	RAS, Moscow
Engineering Sciences	University of Roorkee	Mechanical Engineering Research Institute, Moscow
Mathematics	Institutes of Mathematical Sciences, Chennai	Joint Institute of Nuclear Research, Dubna
Theoretical & Applied Mechanics	Department Of Mechanics, I IIT, Delhi	Institute of Problems in Mechanics, Moscow
Earth Sciences	Indian Institute of Astrophysics, Bangalore	Institute of Physics of the Earth, Moscow
Physics & Astrophysics	Aryabhata Research Institute of Observational Sciences, Nainital	Institute of Astronomy, Moscow
Ecology & Environmental Protection	National Environmental Engineering Research Institute, Nagpur	Institute of Atmospheric Physics, Moscow
Chemical Sciences	National Chemical Laboratory, Pune	RAS, Moscow
Life Sciences	Institute of Genomics & Integrative Biology, Delhi	RAS, Moscow

Joint Council Meetings and No. of Projects Approved

Meeting	Venue	Project Approved	Year
First	New Delhi	45	88
Second	Kishinev	68	89
Third	New Delhi	71	90
Fourth	Moscow	70	92
Fifth	New Delhi	77	93
Sixth	Moscow	84	95
Seventh	New Delhi	88	97
Eighth	Moscow	93	98
Ninth	New Delhi	130	99
Tenth	Chernogolovka	146	01
Eleventh	Banglore	125	02
Twelfth	Moscow	139	04
Thirteenth	New Delhi	111	06
fourteenth	Moscow	117	07

http://www.catalysis.ru/block/index.php? ID=2&SECTION_ID=229

Exchange Visits of Scientists

Year	India	Russia
1988–91	500	785
1992–95	215	320
1996–99	245	395
2000–03	232	293
2004–07	263	223
Total	1455	2016

Joint Projects

Research Area	Implemented	Ongoing
Biotechnology	33	7
Material Science & Technology	52	8
Laser Science & Technology	44	8
Catalysis	17	3
Space Science & Technology	1	
Accelerator	15	7
Hydrology	4	3
Computer & Electronics	16	5
Biomedical Science & Technology	14	12
Oceanology & Oceanic Resources	14	9
Engineering Sciences	24	5
Mathematics	5	
Theoretical & Applied Mechanics	9	1
Earth Sciences	44	25

Physics & Astrophysics	15	6
Ecology & Environmental Protection	6	
Chemical Sciences	23	4
Life sciences	23	6
Others Areas	2	1

http://www.catalysis.ru/block/index.php?ID=2&SECTION_ID=229 accessed on 02/092015

Current Participation Level

Country	Institutes	Scientist
India	85	380
Russia	105	290

B. Indo-Russian Working Group for Cooperation in Science&Technology (IRWGS&T) is one of the major Working Groups under the Indo-Russian Inter-Governmental Commission (IRIGC–TECH), was set up in 1993. Six Working Subgroups have been set up under this Working Group which decide and implement the collaborative research projects. These are listed in the table below.

Area	Collaborative Research Agency	
	India	Russia
Industrial Realization of High Technologies	Department of Science and Technology	Ministry of Education and Science
Biotechnology	Department of Biotechnology	RAS Centre of Bioengineering
Medical Sciences	Indian Council of Medical Research	Russian Academy for Medical Sciences through Institute of Immunology
Meteorology	India Meteorology Department	ROSHYDROMET
Metrology, Standards & Certification	Bureau of Indian Standards (India)	GOST-R
Ocean logy	National Institute of Oceanography	Ministry of Education and Science

These working groups focuses on cooperation in priority areas of biotechnology, building materials, industrial realisation of technologies, medical research, metrology & standardization, meteorology, oceanology and seismology. The Working Subgroups are being administered by the concerned Ministry / Department / Institute who fund their respective collaborative activities.

C. Inter-Academy Exchange Programme

Inter – Academy Exchange Program was initiated in 1970 through an agreement signed between the erstwhile USSR Academy of Sciences and the Indian National Science Academy. The program has since continued by renewal of the agreement every five years. The thrust of this program was on basic sciences. An inter-Academy agreement between INSA and the Russian Academy of Sciences (RAS) was signed in 2001 to facilitate and fund exchange of knowledge and scientists. The Academy has been successfully collaborating with scientific academies/organizations abroad by sharing research experience and

scientific information. Such a relationship has been achieved through bilateral exchange of scientists, collaborative research projects, organization of symposia and meetings.

D. Basic Science Cooperation Programme

Department of Science & Technology (DST), GOI and Russian Foundation for Basic Research (RFBR), supporting joint research projects and bilateral expert meetings / seminars in India and Russia in the areas of Basic Science since 2008. The two sides annually review the priority areas. The current areas include Mathematics, Mechanics and Informatics; Physics and Astronomy; Chemistry; Biology and Medical Sciences; Earth Sciences; Telecommunications and Computer Sciences; Fundamental of Engineering Sciences. As given below in the table number of organization of India involved under RFBR network are listed in the table below:

Area	Societies	Research Institutes	Universities
General	7	5	2
Anthropology		2	8
Archaeology		1	5
Astronomy		7	3
Chemistry	1	15	36
Computer Sciences	1	8	25
Earth Sciences	4	11	34
Life Sciences	7	103	130
Mathematics	2	16	46
Medicine	38	35	79
Physics	1	28	44
Technology	7	64	185

Source: <http://www.cirs-tm.org/> (31/07/2015)

The association between DST and RFBR has launched 133 projects were supported in the areas of Physics, Chemistry, Mathematics, Earth Sciences, Life & Biological Sciences, Engineering Sciences and Telecommunications have since been supported. Of these 88 projects have competed successfully and 85 of the completed projects have resulted in 1161 joint publications, giving an average of 8 papers per project. At least in 91 publications Indian scientists were the first author. Currently around 46 joint R&D projects are under implementation (as on Dec 2013).

Area wise projects sanctioned under “Basic Science Cooperation Programme”
(2008–2014)

Area	No. of Project
Astrophysics	18
Earth Sciences	3
Physics	37
Information Communication & Technology	11
Math	9
Chemistry	26

Biological Science	14
Engineering Sciences	8
Computer Science	5
Medical Sciences	9
Environmental Science	2
Material Science	16
Geosciences	3
Metrology	4

No of Project funded under International S & T co-operation (Russia 2008–14)

Year	No. of Project
2013–14	27
2012–13	12
2011–12	23
2010–11	18
2009–10	45
2008–09	43

Institution wise distribution for India

Area	Name of Institution	No. Of Project
Astrophysics	ARIES	10
	TIFR	4
	Raman Research Centre	1
	Assam University	1
Earth sciences	NGRI	1
	IIT	1
Physics	BIT Mesra	1
	Babha Atomic Research centre	2
	TIFR	3
	IIT	7
	CSIR	1
	Babasaheb Bhimrao Ambedkar University	1
	Delhi University	2
	University of Lucknow	2
	Dr. Vijay Kumar Foundation	1
	Univ. Of Hyderabad	1
	Univ. Of Rajasthan	2
	CPMU, JNCASR, Bangalore	2
	Raja Ramanna Centre for Advanced Technology	1
	Indian Association for the Cultivation of Sciences	1
	Saha Institute of Nuclear Physics (2)	1
	Bhavnagar University	1
	Institute of Physics, Sachivalaya Marg, Bhubaneswar	1
Jamia Milia Islamia	1	
ARIES		

Information Communication & Technology	C-DAC	1
	IIIT (Allahabad)	2
	IISc (Banglore)	1
	NIT (Jaipur)	1
	Malaviya National Institute of Technology	1
	SERC, (IISc Banglore)	1
	ISTAR	1
Math	IISER	1
	TIFR	2
	IIT (M)	2
	CDAC	1
	Centre for DNA Fingerprinting & Diagnostic	1
	University of Allahabad	2
Chemistry	CSIR-North East Institute of Science & Technology	1
	IIT	6
	Jamia Milia Islamia	1
	University of Hyderabad	1
	Hindustan College of Science & Technology	1
	IISER	2
	Bhavnagar University	1
	IISC	1
	BARC(2)	1
	CDAC	1
	Punjab university	1
	NPL	1
IICT	1	
Biological Science	IISER	1
	BIT Mesra,)	1
	Anamali university	1
	JNU(2)	3
	IIT (Ch)	6
	North Orissa University	1
	Devi Ahilya University	1
	IIIT (Allahabad)	1
Engineering Sciences	IIT (M)	5
	BARC	1
	IICT	1

Partners from Russia and India under RFBR Programme

India	Russia
IRSTC Delhi Unit	National Research Tomsk State University
Indian School of Petroleum and Energy	Gubkin Russian State University of Oil and
UPES University of Petroleum and Energy Studies (UPES), Dehradun, India	The Diplomatic Academy of the Ministry of Foreign Affairs of the Russian Federation
eSpeed Solutions Pvt.Ltd., Delhi, India	Russian International Affairs Council

National Institute of Ocean Technology (NIOT)	Centre for Indian Studies at the Institute of Oriental Studies of the Russian Academy of Sciences
International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI)	Non-governmental Scientific and Educational Institution Russian New University (RosNOU)
	Exhibition Centre of the Russian Academy of Sciences
	CALS-technology LTD
	Non-commercial Partnership «Business Council for Cooperation with India at the Russian Federation Chamber of Commerce (BCCI)
	Scientific Production Company “Ruteny” LLC

E. Indo-Russian S&T Centre for two-way Technology transfer and Commercialization (IRSTC)

While continuing to support basic and applied research as well as academic cooperation programmes, scientific cooperation is being focused on translational research and technology development and commercialization. On the initiative of both governments, an Indo-Russian Science and Technology Centre (IRSTC), with its units both in Moscow and in Delhi, was set up to promote two-way technology transfer between Russia and India and commercialize innovative technologies developed jointly or independently by Indian and Russian scientists.

F. Inter-Ministerial Science, Technology and Innovation Cooperation

For implementation of Inter-Ministerial Science, Technology and Innovation Cooperation a Programme of Cooperation (POC) between DST of India and the Russian Ministry of Education & Science (RMES) and between DBT of India and RMES for the period 2014–2017 to deepen cooperation in the field of innovation and S&T, and in the field of biotechnology, respectively were signed during the 14th Session of the India-Russia Annual Summit co-chaired by the Prime Minister of India and the President of the Russian Federation, held at Moscow on Oct 21, 2013. These POCs would support Indo-Russian R&D projects with potential for technology development and generation of new intellectual property.

4. Output Indicators of the Indo-Russian Collaboration

Through charts and tables presented below we make an attempt to measure the level of Indo-Russian collaboration in Science and Technology

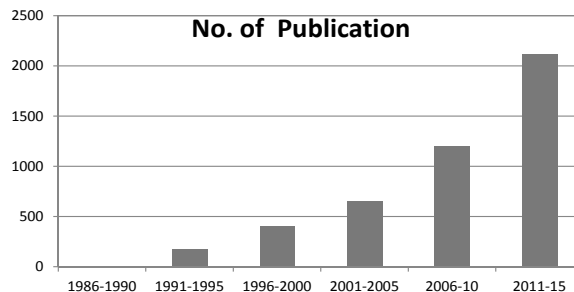


Fig. 2: Number of joint publications by India and Russia between the years 1986 to 2015

The first collaborative publication emerged in the field of Physics in the year 1990.

Research Area	1991–1995	1996–2000	2001–2005	2006–10	2011–2015
Physics	103	294	493	801	1,392
Astronomy Astrophysics	55	176	226	387	753
Chemistry	17	20	29	40	92
Bio Medical Sciences	9	20	48	139	250
Life Sciences	11	23	16	71	144
Earth Sciences	25	32	34	20	69
Mathematics	3		8	12	17
Engineering Sciences	28	56	80	185	243
Chemical Sciences	2	3	5	2	17
Physical Sciences	13	14	18	34	44
Others	3	1	5	9	38

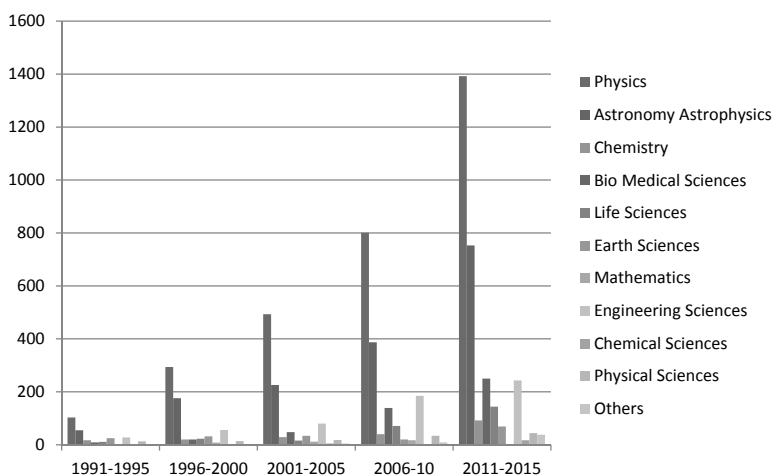


Fig. 3: Joint publications in various fields of Science from the year 1991–2015

The highest no. of joint-publications were in the research area of Physics followed by Astrophysics, Engineering Sciences, Bio Medical Sciences.

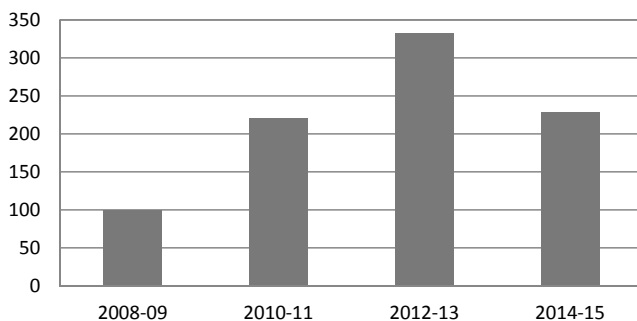


Fig. 4: Papers published under DST-RFBR collaboration between the years 2008–2015

In 2007, Department of Science and Technology (DST) and the Russian Foundation for Basic Research (RFBR) finalised a cooperation agreement for supporting joint research projects.

In the first year of its initiation around 100 papers in various research areas were published. In the year 2012–2013 highest number of papers were published.

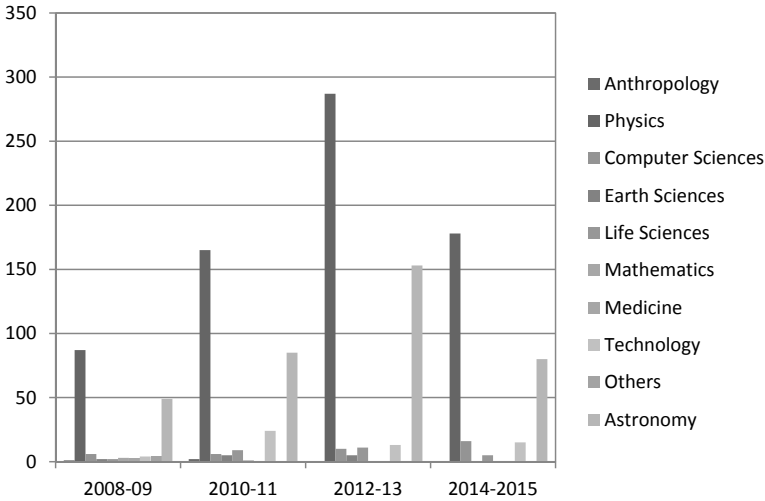


Fig. 5: Area Wise Papers published under DST – RFBR Programme

Highest number of papers were published in the research area of Physics followed by Astronomy and Technology, under DST – RFBR Programme

5. Conclusion

The highly dynamic cooperation in Science & Technology between India and Russia that exists today is the result of decades of initiatives and collaborations that happened in this field. This co-operation facilitated mutual learning process through exchange mechanism with leading institutions in respective specific research areas which improved quality of domestic R&D, encouraging complementarity, enhance competitiveness and economic growth. Indo-Russian cooperation broadened S&T activities across sectors to face the challenges of globalization. S&T cooperation between India and Russia provided a foundation for the science and technology enterprise in India to build its own powerful R&D capabilities in fields as important as astronomy, energy, space technology and also in various discipline of fundamental and applied sciences.

The collaboration has not happened as a side line activity. Science had been at the forefront of the strategy of the Soviet leadership for the development of their country. It retained its eminence after the dismemberment of the USSR, although in the 90’s Russia faced enormous difficulties managing funds for its scientific activities. The Indian “Scientific Policy Resolution” of 1958 speaks of the need to encourage, and initiate, with all possible speed, programmes for the training of scientific and technical personnel for the discovery of new

knowledge to fulfil the country's needs in science and education, agriculture and industry, and defence [<http://dst.gov.in/stsysindia/spr1958.htm>]. The country's political and leadership decided to promote science and technology as a vehicle for the onward journey to progress. During the 1980s, strategic and front-running technologies became increasingly difficult to import. The Indian government, therefore, instituted a policy for "attainment of technological self-reliance" in the Technology Policy Statement in 1983. Three decades later, in radically different settings the Science Technology Innovation Policy document of 2013 takes an entirely different stance, it talks of "permitting multi stakeholders' participation in the Indian R&D system". International collaboration in the Science and Technology endeavour has always been a facet of the S&T policies of both countries, although geo-political conditions have not always been favorable. Nevertheless India and Russia have made the best efforts in this direction and have consequently reaped the benefits.

In this context, the foundation to develop a long term robust Indo-Russian cooperation in S&T was cemented with the launch of ILTP in 1987 during the visit of the then Prime Minister Rajiv Gandhi to the Soviet Union. The ILTP encourages direct contact between scientists and institutions focused on collaborative projects amenable to industrial application and commercial utilization. It emerged as one of the world's largest bilateral programmes in science and technology and led to the genesis of other important programmes between India and Russia that strengthen their bilateral relations in science and technology. Programme like IRIGST and the Basic Science Cooperation Programme are the main institutional mechanism for bilateral science and technology cooperation. Inter Academy Exchange programme to promote knowledge exchange between the science academies of the two countries. Two new institutional forms i. e. Russian-Indian Scientific & Technological Centre, which is focused on technology development and enabling technology transfer and the Inter-Ministerial Science, Technology and Innovation Cooperation in Biotechnology between Indian and Russian scientific / industrial institutions have consequently sprouted. Development of the SARAS Duet aircraft, semiconductor products, super computers, poly-vaccines, laser science and technology, seismology, high-purity materials, software & IT and ayurveda have been some of the priority areas of co-operation.

The flip side of the Indo-Russian science technology cooperation story being that in the 21st century, the collaboration has failed to touch the intensity it reached in the first half of the 1970s. This points out and bespeaks untapped potential. The Indo-Russian Science Technology collaboration venture now awaits wiser handling. Both countries stand to benefit from its rewards.

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