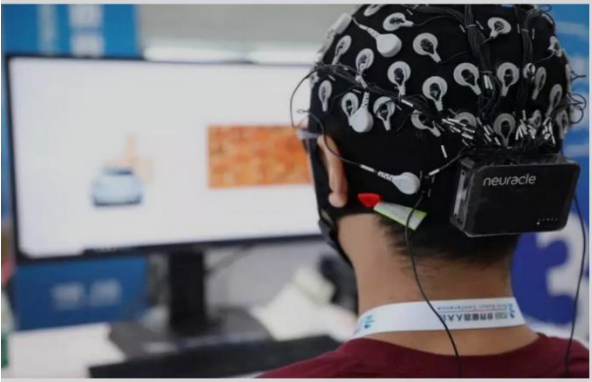


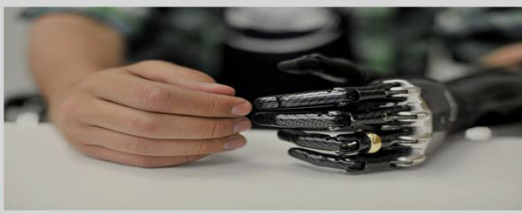
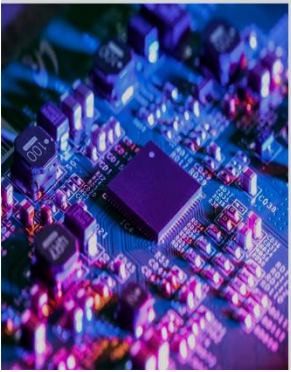



PAKISTAN

STI Profile of the OIC Member State

Science, Technology and Innovation Indicators



COMSTECH

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FOREWORD

It gives me great pleasure to share the *Science, Technology and Innovation Profiles of OIC Member States* as prepared by COMSTECH. These profiles of member states are being printed, as well as shared on the COMSTECH website. A few words are therefore presented to explain the wider aims and purposes of this exercise.

The member countries of the OIC are vigorously engaged with science, technology and innovation, both as a pursuit of knowledge and in harnessing the forces of nature for human betterment. Depending on their circumstances they have advanced to different levels, but much needs to be done, in general, to catch up with the attainments of the more advanced countries. However, there exists a well-defined need to catalogue national efforts in this direction. In particular, to identify respective strengths, achievements and shortcomings, as well as the institutions and policies that are shaping the scientific research and development profiles of OIC member states.

It is with the above goals and purposes that COMSTECH has ventured on this ambitious task viz. preparing a summarized version of the science, technology and innovation landscape of each member state. We have initiated this effort starting with the profiles of countries leading in this area, and will be continuing and sharing as we proceed onwards.

Undoubtedly much more could be said about each country than the summary that we have presented, but our emphasis is on the essentials and on maintaining brevity. COMSTECH welcomes feedback from member states on this effort and will be happy to update the website profiles on the basis of information received officially.

I hope that the scientific community as well as the planners and administrators of member states will find these profiles both useful and inspiring.

Prof. Dr. M. Iqbal Choudhary
Coordinator General COMSTECH
UNESCO Chair

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Following is the list of topics covered in the STI profiles of OIC Member States. All sub-sections/topics may not appear for every country due to unavailability of some data.

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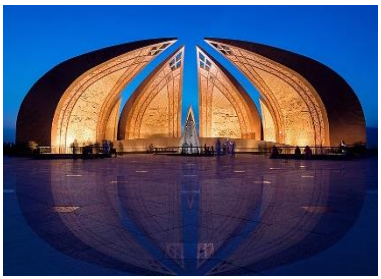
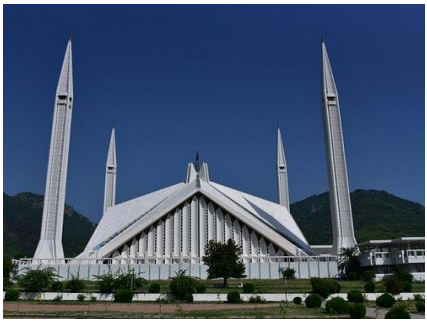
PAKISTAN officially the Islamic Republic of Pakistan, is a populous multi-ethnic country in South Asia. It is the world's fifth-most populous country, with a population exceeding 225.1 million, and has the world's second-largest Muslim population. Pakistan is the 33rd largest country by area, spanning 881,913 square kilometers (340,509 square miles). It has a 1,046-kilometre (650-mile) coastline along the Arabian Sea and Gulf of Oman in the south, and is bordered by India to the east, Afghanistan to the west, Iran to the southwest, and China to the northeast. It is separated narrowly from Tajikistan by Afghanistan's Wakhan Corridor in the north, and also shares a maritime border with Oman.



Pakistan is an influential member of International Atomic Energy Agency (IAEA). Pakistan is also an active member of United Nations (UN), Organisation of Islamic Cooperation (OIC), Shanghai Cooperation Organisation (SCO), Commonwealth of Nations, the South Asian Association for Regional Cooperation (SAARC), the Economic Cooperation Organization (ECO), Non-Aligned Movement (NAM) and the Association of Southeast Asian Nations Regional Forum (ARF).

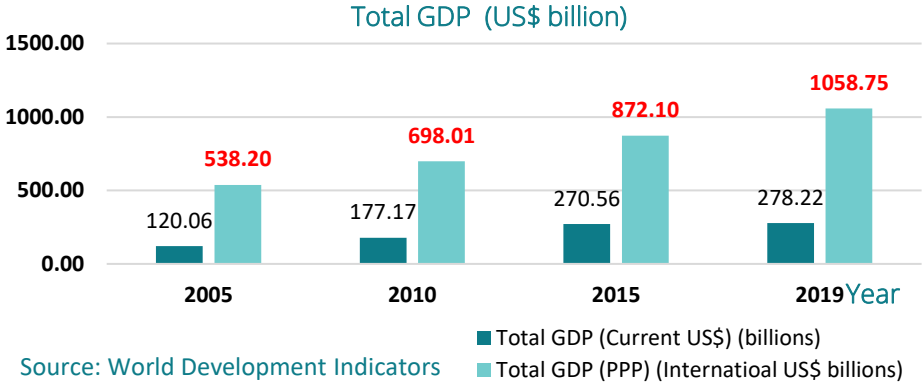
Located in the foothills of the Himalayas mountain range, Islamabad is the capital city of Pakistan. Karachi is the largest city located in the south on the coast of the Arabian Sea. Pakistan encompasses a rich diversity of landscapes, starting in the northwest, from the soaring Pamirs and the Karakoram Range through a maze of mountain ranges, a complex of valleys, and inhospitable plateaus, down to the remarkably even surface of the fertile Indus River plain, which drains southward into the Arabian Sea. It contains a section of the ancient Silk Road and the Khyber Pass, the famous passageway that has brought outside influences into the otherwise isolated subcontinent. Lofty peaks such as K2 and Nanga Parbat, in the Pakistani-administered region of Kashmir, present a challenging lure to mountain climbers. Along the Indus River, the artery of the country, the ancient site of Mohenjo-daro marks one of the cradles of civilization.



The literacy rate of the population is 62.3% as of 2018. The rate of male literacy is 72.5% while the rate of female literacy is 51.8%. Pakistan is currently spending 2.3 percent of its GDP on education.

Source: https://www.britannica.com/place/Pakistan; https://en.wikipedia.org/wiki/Pakistan

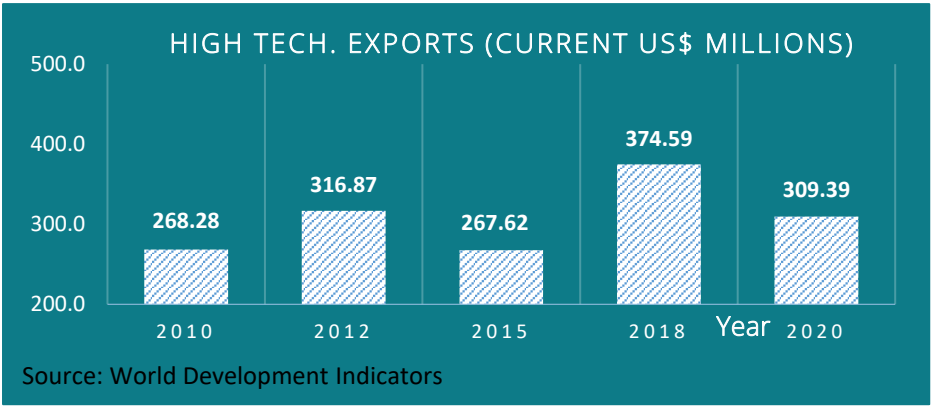
A. ECONOMIC OVERVIEW



Source: World Development Indicators

Between 2005 and 2019, Pakistan's GDP increased by almost 132% in terms of current US dollars, while in terms of the purchasing power parity the GDP increased by 148%. The per capita GDP in current US dollars increased by almost 97% over the same period (2005-2019). In 2020, the GDP showed a slight decline from 278 to 263 billion US$ reflective of the effects of the Corona pandemic. With regards to the sectoral share in the economy, in 2020-2021 fiscal year the services sector contributed over 61%, the industrial sector 19% while the agricultural sector contributed another 19%. Pakistan exports of goods and services as percentage of GDP is 10.12% and imports of goods and services as percentage of GDP is 20.32%. Primary export commodities include textiles, leather goods, sports goods, chemicals and

carpets/rugs. Large scale manufacturing was dominated by textiles (21%), food and beverages (12.3%), coke and petroleum (5.4%), pharmaceuticals (3.6%), non-metallic ferrous products (5.36%) and automobiles (4.6%). Electronics contributed almost 2% to the manufacturing.



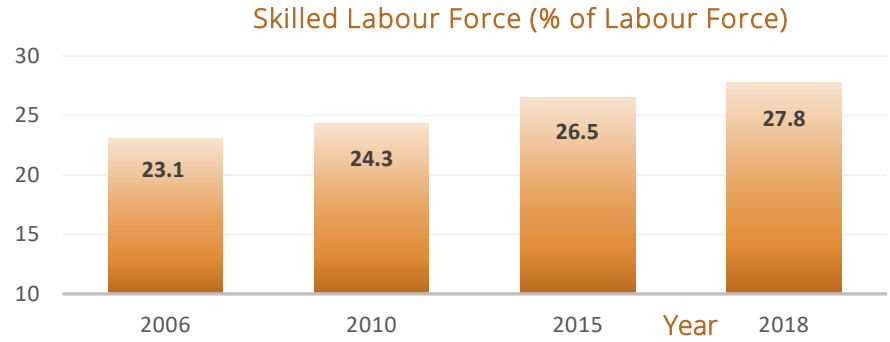
Pakistan's high technology exports remain low and have ranged between US$268 million to 374 million annually in the last ten years. For the 2020 year the high technology exports were valued at US$309 million out of total exports of US$27Billion in 2020. High-technology exports as a percentage of manufactured exports comprised 2.3027 % in 2019, increasing from 1.6% in 2016. During fiscal year 2020/21, Pakistan's IT exports increased 47.4 percent, and crossed $2 billion mark for the first time in the country's history.

CPEC and Economic Development

The China–Pakistan Economic Corridor (CPEC) remains the region's flagship Belt and Road Initiative project. Loans estimated at about US$ 62 billion cover road and port infrastructure development linking Pakistan's northern region to Gwadar Port in the Arabian Sea, coupled with the development of primarily coal- and oil-fired power plants. Among investments are a US$ 9.1 billion project to modernize Pakistan's railway network and an ambitious plan to set up special

economic zones occupied by Chinese and joint ventures between Pakistani and Chinese industrial entities. Much of the initial investment took the shape of private investment in Pakistan's power sector followed by smaller investments in regional connectivity: three north–south corridors, to be funded in phases, connecting China's western region through the Pakistani port city of Gwadar to the Arabian Sea, complete with fibre-optic connectivity and a special development package for Gwadar comprising an airport, a sea port and other infrastructure. The Longterm Plan envisions further investment in infrastructure projects, such as the refurbishment of the railway track connecting the north and south of Pakistan, as well as, potentially, the construction of water reservoirs and dams.

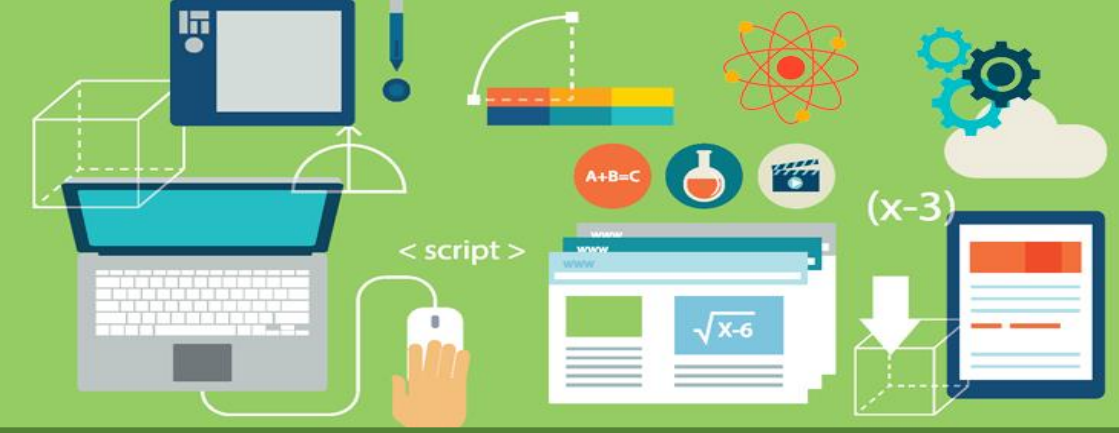
B. SOCIAL AND HUMAN DEVELOPMENT



Source: Human Development Report

There was a consistent and significant decline in poverty in Pakistan over the 14 years from 2001 to 2015, when the poverty headcount measured using the national poverty line fell from 64.3 percent to 24.3 percent. The increase in employment opportunities outside the agriculture sector was the main driver of poverty reduction over this period. (However, according to international Poverty headcount ratio at $5.50/day (2011 PPP) the poverty rates decreased from 93.7% in 2001 to 76.2% in 2018).

Life expectancy increased from almost 64 years in 2005 to over 67 years in 2019. In 2019 almost 74 percent of the population has access to electricity while almost 26% has access to piped drinking water. The percentage of skilled labour force has risen slightly, from 23.1% in 2006 to 27.8% in 2018. 17% of the population has access to the internet while mobile cellular subscriptions equal 79.5% of the total population. Broadband penetration is reported at 49% of population.



C. KEY GOVERNMENT ORGANIZATIONS RELATED TO SCIENCE, TECHNOLOGY AND HIGHER EDUCATION

❖ **Policy Structure**

Up until now, policy has been driven primarily by two policy frameworks, Pakistan Vision 2025 (2014) and the National Science, Technology and Innovation Policy (2012). The National Science and Technology Commission, is the apex policy-making body. Pakistan Vision 2025 rests on seven pillars that include investment in human capital, creation of the conditions for a knowledge economy and laying the foundations for growth in a process led by the private sector, in general, and entrepreneurship, in particular. Two task forces have been set up since 2019, one on Science, Technology and the Knowledge Economy and the other on Science and Technology. These task forces have been mandated to undertake science planning and implementation outside formal government structures.

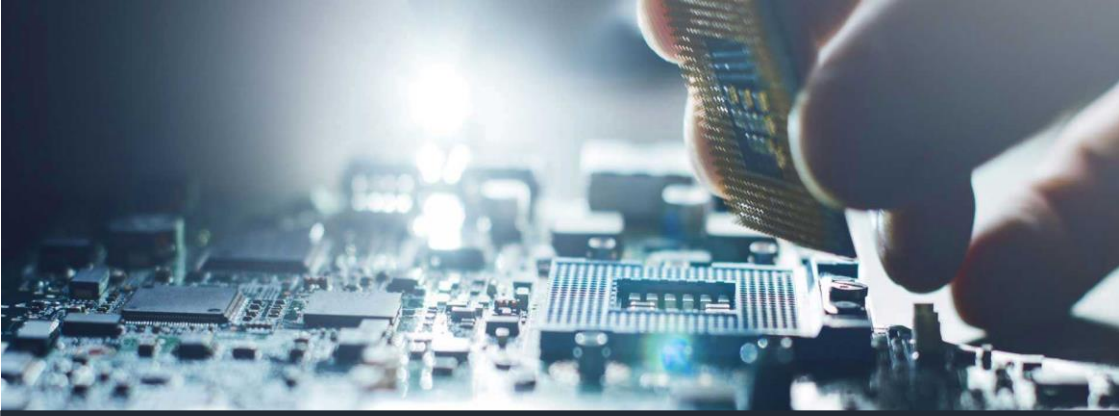
❖ **The Ministry of Science and Technology:**

The Ministry of Science and Technology (MoST) is the national focal point and enabling arm of Government of Pakistan for planning, coordinating and directing efforts; to initiate and launch scientific and technological programs and projects as per national agenda for sound and sustainable S&TR base for the socio-economic development.

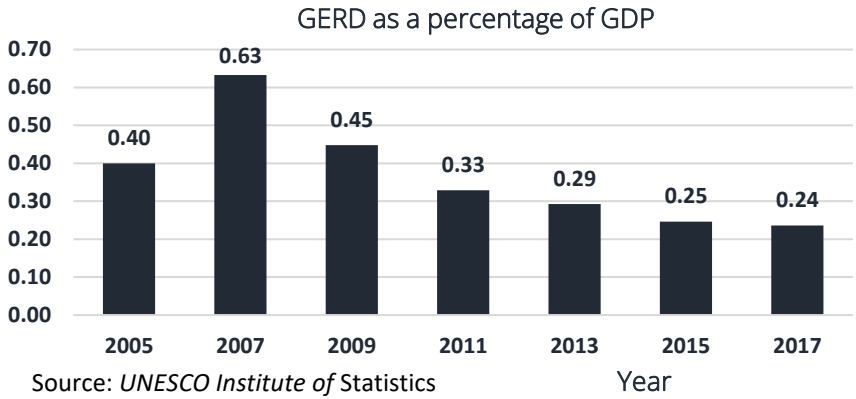
In 2019, under the banner of **"ThinkFuture"**, the Ministry has started an ambitious program to reimagine the future of Pakistan focussing on seven key emerging technologies, including 3D Printing, Artificial Intelligence, Augmented Reality, Blockchain, Internet of Things, Intelligent Vehicles, and Smart Robots. This program aims to develop a roadmap to create technology solutions to indigenous problems, and launch national scale projects to accelerate the adoption these technologies.

❖ Major Research Centres and Institutes:

- National Institute of Electronics (NIE)
- National Institute of Oceanography (NIO)
- National Centre for Physics (NCP)
- International Centre for Chemical and Biological Sciences (ICCBS), Karachi.
- Pakistan Council for Renewable Energy Technologies (PCRET)
- Pakistan Council of Research in Water Resources (PCRWR)
- Pakistan Council of Scientific and Industrial Research (PCSIR)
- Geological Survey of Pakistan, Rawalpindi
- National Institute of Biotechnology and Genetic Engineering (NIBGE), Faisalabad
- National Institute of Health (NIH), Islamabad
- Nuclear Institute of Agricultural Biology (NIAB), Faisalabad
- Pakistan Agricultural Research Council (PARC), Islamabad
- Pakistan Atomic Energy Commission (PAEC), Islamabad
- Space and Upper Atmosphere Research Council (SUPARCO), Karachi



D. RESEARCH AND DEVELOPMENT



Source: *UNESCO Institute of* Statistics

Pakistan's investment in research and development as manifested in its Gross Expenditure on Research and Development (GERD) peaked at 0.63% of the GDP in 2007. It has since continued to decline consistently and was 0.24% in 2017. The data of GERD for Pakistan may be underestimated, though, as they do not capture the defence and strategic sectors which concentrate a sizeable share of Pakistan's human and financial investment in research). Pakistan had 354 researchers per million (FTE) in 2017, up from 294 in 2015. The number of researchers per million (headcount) has also increased strongly in recent years and reached 624 in 2017. Almost 93% of the

researchers are employed by higher education sector and 7.6% by the government. Almost 30% of these are in the field of natural sciences, 14.5% in engineering, 11% in agriculture and about 31% in social sciences and humanities. Female researchers account for about 39% of all researchers in Pakistan.

1. Expenditure on R&D by Sectors:

Almost the entire funding is from government sources, with 62% coming from government sources directly and 35% from higher education institutions. The share of the private sector is negligible with a 5% contribution as a rough estimate, as no real data on the same is available. A few exceptions can be noted:

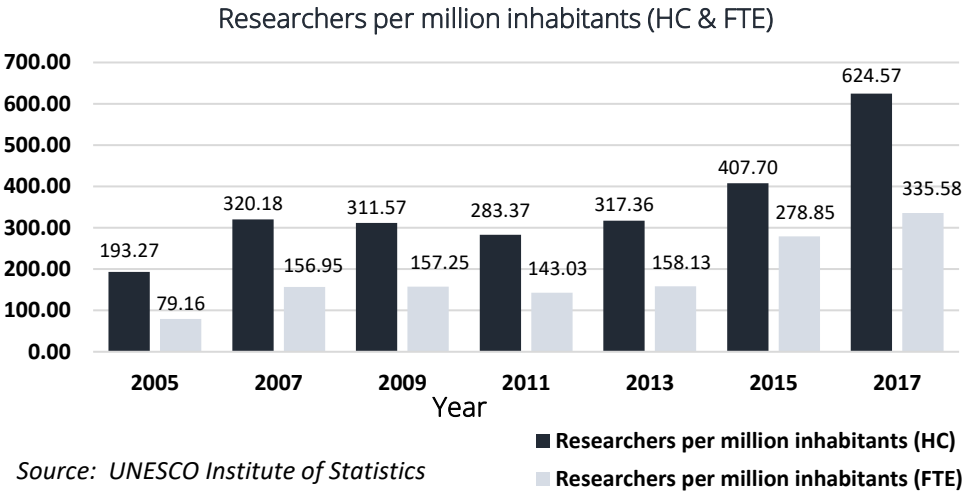
a. Pakistan's telecom industry has been mandated by the government to allocate a certain percentage of their gross revenue to R&D in the ICT sector. For this purpose, an ICT R&D Fund (IGNITE) has been created with the vision to transform the country's economy into a knowledge based economy.

b. Under the Ministry of Health, a '**Central Research Fund**' has been created for the promotion of research and development, where the pharma companies are contributing 1% of their profits since 1976. Unfortunately, this research fund has mostly remained unused resulting in very little research with negligible impact on pharma industry.

Source: Science, Technology and Development 37 (3): 139-148, 2018 http://docsdrive.com/pdfs/std/std/2018/139-148.pdf

2. Researchers Intensity:

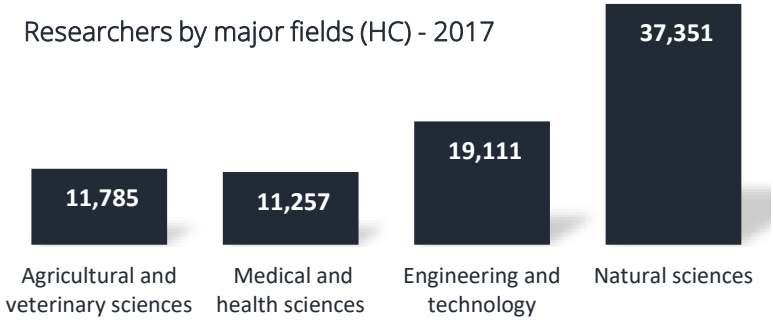
The variation of Pakistan's research intensity is shown in the accompanying figure and shows a steady growth since 2005 with a strong increase between 2015 and 2017 reaching a headcount of about 625 per million in 2017.



Source: UNESCO Institute of Statistics

3. Researchers distribution by major fields:

Most of Pakistan's researchers are concentrated in the fields of natural sciences and engineering and technology, respectively, with significantly smaller numbers in medical and health sciences and agriculture. Almost 47% of the researchers are concentrated in fields of natural sciences. This is mainly due to the concentration of researchers in higher education institutions with their focus on natural sciences. The lack of researchers in engineering and technology and agriculture is noticeable and indicative of a disconnect between industry and research, which is overwhelmingly academic.

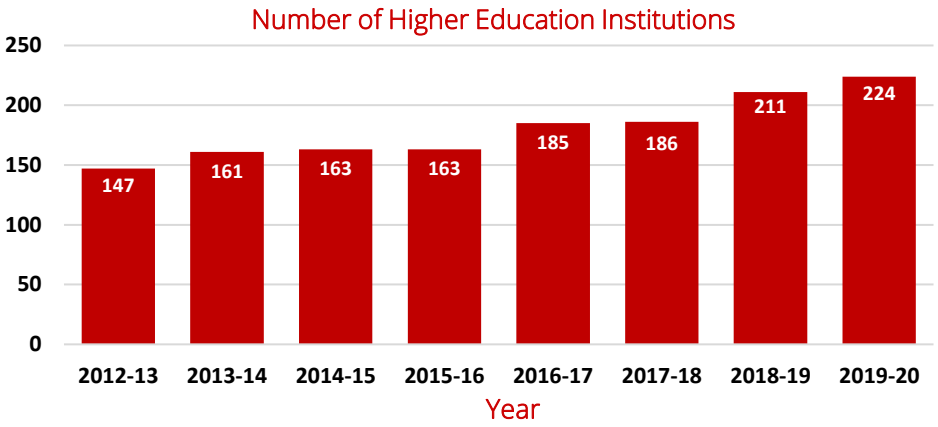


Source: UNESCO Institute for Statistics (UIS)

CPEC and Scientific Development

Pakistani–Chinese collaboration has recently extended to science and technology. China has expressed interest in helping to fund a number of research institutes, including a research centre in the north specializing in natural disaster risk reduction and a state-of-the-art university on new technologies. A Consortium of Business Schools connected to the China–Pakistan Economic Corridor has been established and subsequently expanded to include universities, in order to enhance academic co-operation between the two countries. Business-to-business collaboration, particularly in high-tech areas, is also being explored. On the back of the successful launch of a Chinese-built remote sensing satellite (PRSS-1) and an endogenously developed test satellite (PAK-TES1) on 9 July 2018, the Pakistan Space and Upper Atmosphere Research Commission, Pakistan's space agency, has entered into a strategic collaboration with China to set up a US$ 250 million Pakistan Space Centre – Satellite Assembly, Integration and Testing Facility that would be the first of its kind in Pakistan.

E. HIGHER EDUCATION



Source: Pakistan Economic Survey (2020-21)
http://www.finance.gov.pk/survey/chapters_21/10-Education.pdf

- In 2018 Pakistan spent a total of 2.9% of its GDP on education and 0.6% on tertiary education. There are a total of 224 universities, both public and private, having 60.3 thousand teachers in 2018-19. The number of universities has increased from 147 since 2012-13, showing an increase of over fifty-two percent (52%). The overall enrolment in higher education is reported at 1.86 million. The gross enrolment ratio actually dropped between 2014 and 2018, from 9.7% to 9.0% of the 18–25-year-old cohort.

- One achievement has been gender parity, with women accounting for 45% of enrolled students by 2018. In degree colleges (grades 13 to 16) an enrolment of 0.59 million students is expected during 2019-20. During 2018-19, 3900 technical and vocational institutes with 18.2 thousand teachers were functional at the national level. The enrolment has not shown any increase compared to 2017-18 and is stagnant at 0.43 million. Pakistan produced 14151 PhD's during the 2009-2019 period in different disciplines. This includes 2160 government supported scholars who completed their PhDs in foreign universities.

- **Technical Universities:**

  The following universities in Pakistan are dedicated to engineering, technology and sciences.

  - National University of Sciences and Technology, Islamabad
  - Pakistan Institute of Engineering and Applied Sciences, Islamabad
  - University of Engineering & Technology, Lahore
  - Ghulam Ishaq Khan Institute of Engineering Sciences and Technology
  - University of Engineering & Technology, Peshawar
  - Institute of Space Technology, Islamabad
  - Air University, Islamabad
  - Mehran University of Engineering & Technology, Jamshoro
  - NED University of Engineering & Technology, Karachi
  - University of Engineering and Technology, Taxila

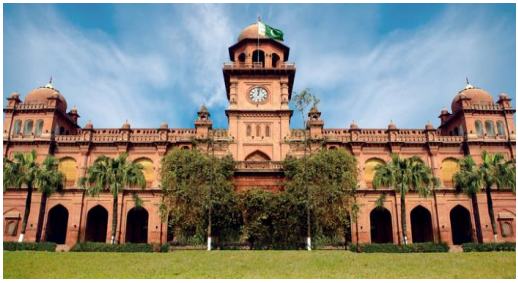

❖ New Initiatives in higher education:

- In line with the vision of the government to promote a knowledge economy and to develop high level manpower with innovative skills, engineering and technology universities are being established locally in partnership with foreign universities. **The Pak-Austria Fachhochschule Institute of Applied Science and Technology** has already been established at Haripur, Khyber Pakhtunkhwa. Along the same lines a second new university will be set up with similar foreign partnerships with Austria and China in Samrial, Sialkot, right at the center of the industrial hub of Pakistan. These institutes are a collaborative public sector venture in partnership with premier Austrian and Chinese universities. Artificial Intelligence, Agriculture Food Technologies, Mineral Resource Engineering, Nano-Technology Center and Railway Systems Engineering are the currently active departments. The heart of these universities will be technology parks to foster innovation and promote new start-up companies with close linkages with the Austrian, Chinese and Pakistani industries. Emphasis will be on applied research of industrial importance.

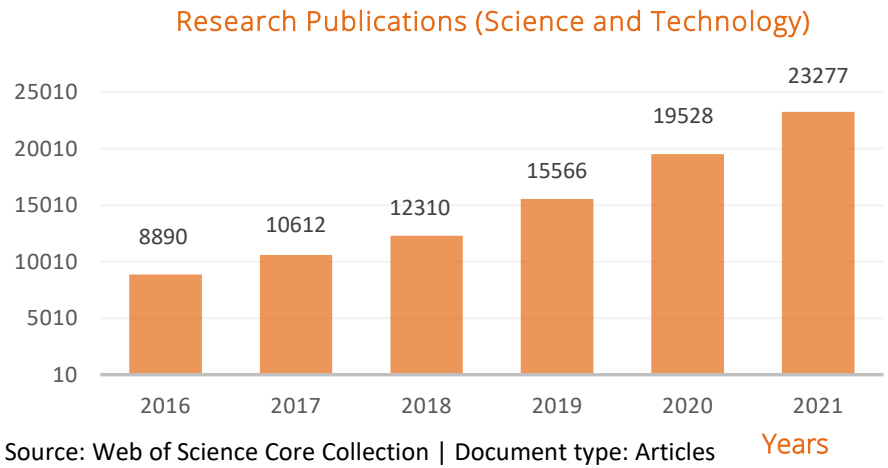
- Another major initiative being undertaken is the initiation of a huge Rs12 billion scholarship programme for sending the brightest students for PhD level studies to the top 100 universities of the world and to absorb them within our institutions on their return to Pakistan.

University Name	National Ranking	Global Ranking
Quaid-i-Azam University	1	742
COMSATS University Islamabad	2	809
Agha Khan University	3	1082
University of the Punjab	4	1255
University of Agriculture Faisalabad	5	1340
National University of Sciences and Technology Islamabad	6	1456
University of Peshawar	7	1785
Bahauddin Zakariya University	8	1822
Government College University Faisalabad	9	1853
University of Karachi	10	1874

Source: https://cwur.org/2021-22/country/pakistan.php



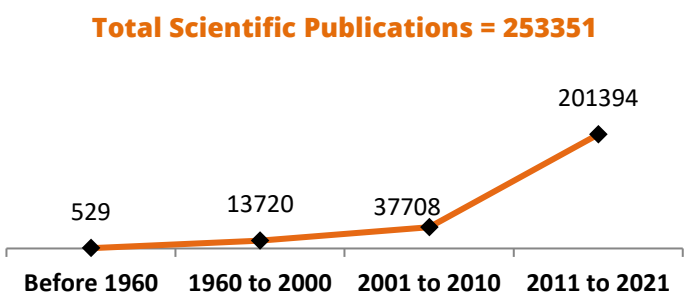
F. RESEARCH PUBLICATIONS



Source: Web of Science Core Collection | Document type: Articles

- Pakistan continues to show a marked increase in research publications. The number of research publications in impact factor journals of science and technology, according to the Web of Science, has increased by about 161% from 8890 in 2016 to 23277 in 2021. Pakistan has reached a figure of one hundred publications per millions of population in 2019. Based on the number of publications in respective disciplines, health sciences (26%), cross cutting strategic disciplines (16%), ICT, Maths, Stats (13%), and physics and astronomy (12%) constitute the most productive areas. According to COMSTECH search, Pakistan ranks 5th in the OIC in terms of the total number of scientific publications in impact factor

journals. China, Saudia Arabia, USA, UK and Malaysia are the top research partners in Pakistani scientific publications.



Source: Scopus

- As shown in the figure, Pakistan has published 253351 research documents in twenty-seven (n=27) different research categories of life sciences, natural sciences, medicine, engineering and arts and humanities, etc. By a closer inspection of the data it is apparent that 75.66% documents (n=191695) are published in the last decade (from 2012 to 2021).

S#	Title	Overall	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1	SO	191695	10129	11636	11750	12712	14896	17977	20869	24990	29675	37061
2	Citations	2330951	180193	203401	207094	228104	261699	298540	286897	276409	253339	135275
3	FWCI	1.26	0.91	0.92	1.01	1.04	1.19	1.2	1.2	1.29	1.41	1.56
4	CPP	12.2	17.8	17.5	17.6	17.9	17.6	16.6	13.7	11.1	8.5	3.7

- For each year, the **scholarly output (SO)**, **citations**, **citations per publications (CPP)**, and **field-weighted citations impact (FWCI)** of all (n=191695) documents are presented in the table. The field weighted citation impact (FWCI) "indicates how the number of citations received by an article compares to the average or expected number of citations received by other similar publications". As shown in the table, the number of publications increased per year i.e. from 2012 to 2021. All documents received 2330951 citations, with 1.26 FWCI and 12.2 CPP. 1.26 FWCI means, that the articles received 26 % higher citations as compared with global average.

S#	Subject Area	SO	Citations	Authors	CPP	FWCI
1	Medicine	40421	471735	58063	11.7	1.18
2	Engineering	37151	435530	35204	11.7	1.5
3	Computer Science	30426	288647	28650	9.5	1.4
4	Physics and Astronomy	25810	407470	20588	15.8	1.57
5	Agricultural and Biological Sciences	25539	254594	28100	10	0.92
6	Materials Science	22879	302281	22467	13.2	1.32
7	Chemistry	19169	296784	19616	15.5	1.23
8	Mathematics	19160	172311	17537	9	1.71
9	Biochemistry, Genetics and Molecular Biology	18083	276128	24864	15.3	1.15
10	Environmental Science	15233	267947	19662	17.6	1.55
11	Social Sciences	10379	81437	13903	7.8	1.44
12	Chemical Engineering	10200	180672	13293	17.7	1.51
13	Energy	9536	161221	13781	16.9	1.54
14	Pharmacology, Toxicology and Pharmaceutics	9396	108416	13892	11.5	0.95
15	Business, Management and Accounting	6266	66460	7877	10.6	1.55
16	Earth and Planetary Sciences	5202	56966	6602	11	1.01
17	Multidisciplinary	4940	88698	10462	18	0.99
18	Immunology and Microbiology	4903	72036	8875	14.7	1.06
19	Economics, Econometrics and Finance	4123	47399	4969	11.5	1.73
20	Decision Sciences	3835	26697	6664	7	1.28
21	Nursing	2527	13161	6274	5.2	0.59
22	Arts and Humanities	2226	10988	2980	4.9	1.42
23	Veterinary	2139	16917	4212	7.9	1.2
24	Health Professions	1813	14985	4897	8.3	1.16
25	Psychology	1679	15199	2555	9.1	1.44
26	Neuroscience	1339	23910	2611	17.9	1.52
27	Dentistry	598	4409	1192	7.4	0.92

Source: Scopus

- Pakistan has published the highest number of documents in Medicine (n=40421), Engineering (n=37151), Computer Science (n=30426), Physics and Astronomy (n=25810) and Agricultural and Biological Sciences (n=25539). While, the lowest number of documents are published in dentistry (n=598), followed by neuroscience (n=1339) and psychology (n=1679). In the table, we also provided total number of citations, number of authors, citations per paper (CPP) and field weighted citation impact (FWCI). It is important to note that Scopus provides ranking details of all sources/journals. They are categories in seven quartile sets. The top 1% or the highest ranked journals are included in Q1 and Q7 is occupied by journals in the 75 to 100% group. The ten years data is presented in the accompanied table.

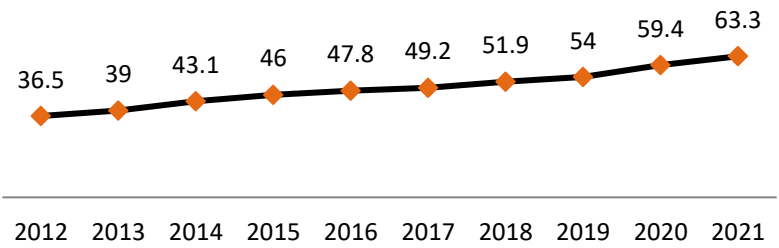
S#	Title	Overall	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
1.	Pub in top 1% Sources (Q1)	2558	119	154	199	237	318	291	220	237	313	470
2.	Pub in top 1% (Percent)	1	0.8	0.9	1	1	1.3	1.1	0.8	0.7	0.9	1.2
3.	Pub in top 5% Sources(Q2	17361	1103	1131	1613	1536	1608	1821	1745	1727	2062	3015
4.	Pub in top 5% (Percent)	6.8	7.5	6.4	8.2	6.8	6.5	6.8	6.4	5.4	6.1	7.9
5.	Pub in top 10% Sources(Q3)	35749	1903	2345	2685	3309	3485	3695	3509	3746	4730	6342
6.	Pub in top 10% (Percent)	13.9	13	13.2	13.6	14.6	14.1	13.7	12.9	11.7	14.1	16.7
7.	Pub in top 25% Sources(Q4)	78201	4447	5212	6042	6897	7043	7352	7432	8486	10647	14643
8.	Pub in top 25% (Percent)	30.4	30.4	29.3	30.7	30.5	28.4	27.3	27.4	26.5	31.7	38.5
9.	Pub in top 50% Sources(Q5)	135958	8060	9743	11040	11750	12314	12961	13767	15192	17770	23361
10.	Pub in top 50% (Percent)	52.9	55	54.8	56.1	52	49.7	48.1	50.7	47.5	52.9	61.4
11.	Pub in top 75% Sources(Q6)	195364	12091	13911	15698	16779	17916	18842	20545	24368	24751	30463
12.	Pub in top 75% (Percent)	76	82.5	78.3	79.8	74.2	72.3	70	75.6	76.2	73.7	80
13.	Pub in top 100% Sources(Q7)	257164	14652	17766	19681	22602	24773	26921	27162	31975	33568	38064
14.	Pub in top 100% (Percent)	100	100	100	100	100	100	100	100	100	100	100

- 23452 documents are published in those sources, which do not have citescore data or in other words it does not have any ranking. While 87.76% (or 168243) documents are published in Q1 TO Q7 sets. The highest documents are published in Q5 sources i.e. 28% or 47160, followed by Q4 (20.71 % or 34882) and Q6 (20.70 or 34735). The per year break up for all sets are presented in table.

S#	Institution	SO	Citations	Authors	CPP	FWCI
1	COMSATS University Islamabad	22164	337941	8078	15.2	1.52
2	Quaid-I-Azam University	14466	295877	5044	20.5	1.72
3	National University of Sciences and Technology Pakistan	13076	148850	7300	11.4	1.23
4	University of the Punjab	11625	144391	5649	12.4	1.29
5	University of Agriculture Faisalabad	10545	153685	5390	14.6	1.21
6	Aga Khan University	7951	220979	4917	27.8	2.67
7	University of Karachi	6622	59863	3522	9	0.72
8	Government College University Faisalabad	6477	95512	2991	14.7	1.57
9	Bahauddin Zakariya University	6195	79061	3007	12.8	1.11
10	University of Peshawar	5739	68376	3166	11.9	1.13

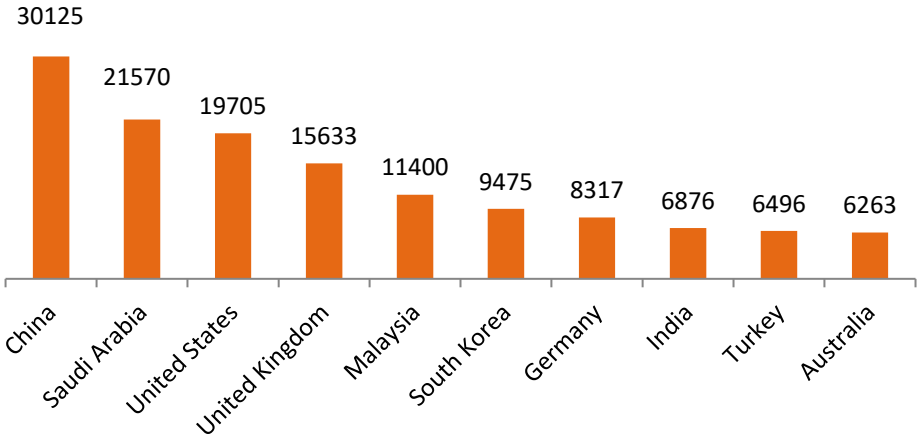
- The list of top ten most productive universities along with citations, number of authors, CPP and FWCI is also provided. Based on the number of publications, the highest documents are published by COMSATS University Islamabad (n=22164), Quaid-I-Azam University (n=14466) and National University of Sciences and Technology Pakistan (n=13076).

International Collaboration (%)



- The percentage of international collaborations in the domain of research publications for the last ten years are also depicted in the accompanying figure. The average degree of collaboration for the last ten years was found to be 52.4. While, the peak international collaboration percentage (n=63.6) was recorded for the year 2021.

The Top Ten Collaborating Countries in Pakistan



- It is worthy to note that Scopus provides collaborating details for 160 countries. Pakistan published at least 500 research publications with 76 countries. From 2012 to 2021, the highest documents were published (in collaboration) with China (n=30125), KSA (n=21570), and USA (n=19705).

Source: Scopus

G. International Cooperation and Support Initiatives (selected)

- Pakistan and Turkey collaborate via the Pak-Turk Researchers' Mobility Grant Program 2017 within the scope of internationalization effort of higher education systems. It is implemented in Turkey by the Council of Higher Education (CoHE) and in Pakistan by the Higher Education Commission (HEC). https://www.hec.gov.pk/english/services/faculty/PTRG/Pages/default.aspx

- Pakistan and China cooperate on joint scientific projects ad exchange visits of students and scientists under an agreement between the Pakistan Science foundation (PSF) and National Natural Science Foundation of China (NNSFC). "CPEC Science Communication Network" is a recent initiative for cooperation between the two countries launched recently (December 3rd 2020) during the 5th Academic Forum on China-Pakistan Scientific, Technological and Economic Cooperation under Belt and Road Initiative.

- Pakistan along with 17 other member states of the OIC is a member of COMSATS, the Commission on Science and Technology for Sustainable Development in the South (COMSATS).

It ws established in 1994 with the plan to support and catalyze the socio-economic uplift of the developing countries by promoting and inculcating S&T as an effective means of development.

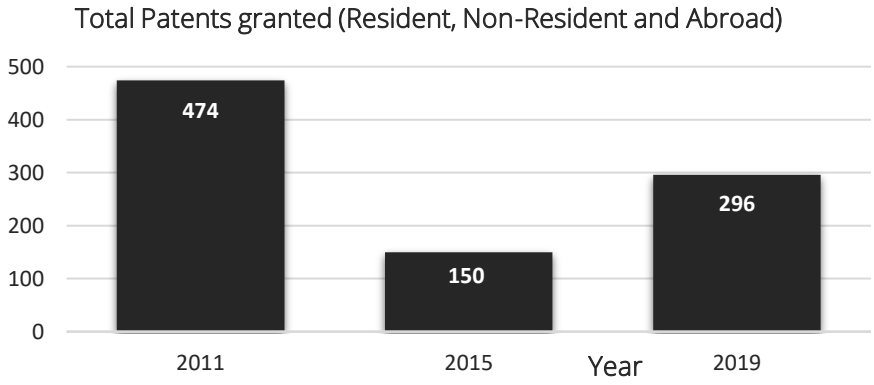
- The U.S.-Pakistan Science and Technology Cooperation Program develops collaboration in science, technology, engineering, and education for mutual benefit and peaceful purposes in both countries. This program is co-sponsored by USAID and the Department of State and is implemented by the U.S. National Academy of Sciences in coordination with the Pakistani Ministry of Science and Technology and the Higher Education Commission of Pakistan.
  https://www.usaid.gov/news-information/fact-sheets/us-pakistan-science-technology-cooperative-program

- Pakistan is the host country of COMSTECH and from its platform contributes generously to a large number of scientific cooperation programs between OIC member states. www.comstech.org

- Pakistan is an Associate member of CERN, the international collaboration of high energy physics at CERN, Geneva, and participates actively in several of its research programs.
  https://international-relations.web.cern.ch/stakeholder-relations/states/pakistan.

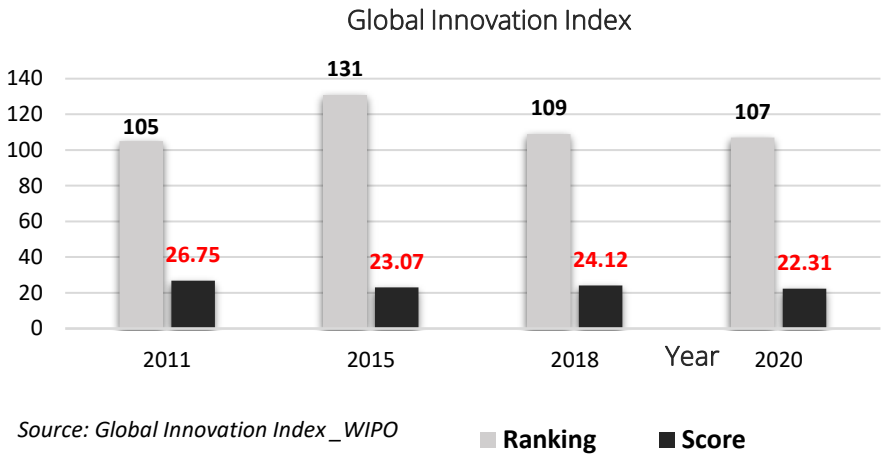
- Pakistan is also an active member of the international collaboration SESAME, the Synchrotron light source in Jordan.
  https://www.sciencediplomacy.org/perspective/2012/synchrotron-light-and-middle-east.
  Several other OIC member states are part of both these collaborations.

H. INNOVATION, ENTREPRENEURSHIP & TECHNOLOGY PARKS



*Source: WIPO: https://*www.wipo.int/ipstats/en/statistics/country_profile/profile.jsp?code=PK

With regards to the number of patents granted Pakistan's recent record does not show a strong trend. The number has actually decreased between 2011 (474) and 2019 (296). Pakistan's score and ranking in the Global Innovation Index does not exhibit any major change with the country being ranked 107th globally with a score of 22.31. This suggests that Pakistan needs to make significant improvements in its innovation ecosystem to realize its potential.



Source: Global Innovation Index _WIPO

There is however a different picture with regards to freelance operations in Pakistan. **Payoneer's Global Gig Economy Index**, published by Forbes, ranked Pakistan as the fourth-fastest growing market for freelancing in the world. The entrepreneurial ecosystem in Pakistan is rapidly expanding. Starting with Plan9 in 2012, Pakistan now hosts a number of private incubators and accelerators. Start-up funds such as Sarmayacar, Invest2Innovate, 47 Ventures, Fatima Ventures, TPL e-Ventures and Planet N have begun investing heavily in early-stage start-ups, alongside several foreign funds. There are a number of other non-traditional and grant based funding vehicles supporting entrepreneurs and startups through sector-specific and general grants. Another positive trend in the innovation ecosystem has been the rapid growth in the penetration of smartphones and high-speed mobile broadband. In 2013 smartphone penetration stood at about 5% of the total market, compared to 48% today. The country is gearing towards limited testing and deployment of 5G systems in the near future.

TECHNOPARKS AND INCUBATION CENTRES

- The Ministry of Information Technology and Telecommunications (MoITT) has led the process to create national incubation centres in Islamabad and four provincial capitals in 2016 and 2017. This programme is spearheaded by the **Ignite National Technology Fund**. MoITT and Punjab Information Technology Board (PITB) in collaboration with public universities are launching the largest network of technology incubation centers across Pakistan.
- In 2018, the Higher Education Commission (HEC) established four national centres, namely the National Centres for Artificial Intelligence; Robotics and Automation; Big Data and Cloud Computing; and Cybersecurity. Each of these four national centres is a consortium of 10–12 laboratories spread across the country, coordinated by the national hub. Over 300 postdoctoral researchers work across these 46 laboratories, along with hundreds of PhD and master's students, research associates and assistants.

TECHNOPARKS

- National Science and Technology Park (NSTP). Inaugurated in December 2019, NSTP is Pakistan's first Science and Technology Park, located in the heart of Islamabad.
- Arfa Software Technology Park, Lahore, initiated in 2012 under the auspices of the Punjab Software Technology Board.
- Aiwan e Iqbal Software Technology Park, Lahore
- Shaheen Complex Software Technology Park, Lahore
- Anjuman Himayat e Islam Software Technology Park, Lahore
- Netsol IT Village, Lahore
- JGC Descon Software Technology Park, Lahore
- Imran House Software Technology Park, Lahore
- TRG Complex Software Technology Park, Lahore
- Systems Software Technology Park, Lahore
- Awami Markaz Software Technology Park, Islamabad
- Evacee Trust Complex Software Technology Park, Islamabad
- KSL Software Technology Park, Islamabad

- Rose Center Software Technology Park, Rawalpindi
- Meridian Software Technology Park, Rawalpindi
- ICCBS Technology park and Technology Incubation Centre, Karachi
- Scientific and Technological Development Centre (STEDEC), Lahore
- COMSATS Internet Services (CIS) Technology park, Islamabad
- National Aerospace Science and Technology Park (NASTP) being developed as Pakistan's first Aerospace Cluster and Smart City
- Pakistan Software Exchange Board IT Park, Islamabad (under construction)
- Information Technology Park, Karachi, to house about 210 IT companies having 8,400 employees (under construction)

I. COMBATING THE COVID-19 PANDEMIC

❖ Vaccine Development and administration:

- As of November 2021, nearly 48.6 million people have received two doses of COVID-19 vaccine, and more than 78.5 million have received one dose. The country, which launched its COVID-19 vaccination campaign one year after the first case was reported, administered over one million doses of vaccine in a day. The daily reported cases had declined to between two and three hundred.

- Pakistan in June 2021 launched its homemade Covid-19 vaccine named **"PakVac"** which it developed with the help of China. Pakistan has started producing the single dose Chinese CanSinoBio (6185.HK) COVID-19 vaccine to be able to deliver 3 million doses a month.

❖ Indigenous production to meet pandemic requirements:

- Pakistani entities have developed a range of products and services related to the Corona pandemic. These include medical equipment as well as AI technology for detection, monitoring and advanced medical treatment. Indigenous products that are readily available include several types of ventilators, air purifiers, oxygen concentrators, thermal cameras, UV disinfectant walk though gates, smart sanitizer, Face Shield, Googles-Eye Protection and Corona Symptom

Detector Masks etc. AERON Aerial Spraying Unit- Low Weight Drone 10Kg Pay Load Capacity (ASU), and N-ROVER Tele Operated Decontamination Robot – Unmanned Ground Vehicle for disinfection (TODR) have also been developed.

- The Pakistan Engineering Council has brought together innovators, manufacturers and the regulator to produce a homemade, low-cost lung ventilator.

❖ **Mobile application to support the country's efforts to curb the spread of the novel coronavirus.**

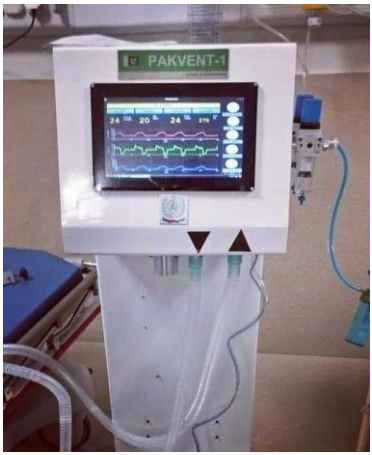
- The National Information Technology Board (NITB) has developed a **"Covid-19 Gov Pk"** application to provide awareness and take preventive measures for general public. The application also contains WHO informative videos.
- A Corona Awareness Web Portal and **Helpline 1166** has been launched by National Institute of Health and National Information Technology Board (NITB).

❖ **Drug development for treatment of COVID-19 and post COVID situations.**

- Pakistan has established a nationwide network comprising 14 major research centers. Under this network, the Pakistan Randomized and Observational Trial for Evaluation of Covid-19 Treatment (PROTECT) study has been initiated. It is a randomized Controlled Clinical trial study to evaluate Hydroxychloroquine (HCQ) alone and in various drug combinations with Azithromycin and Ostelmavir for treatment of COVID. 100 patients have already been treated with the PROTECT protocol. Other OIC member states participation in PROTECT clinical trials includes Iran, Lebanon and Sudan.

❖ Determination of the Structure of the COVID-19 Virus Strain Found in Pakistan.

The Turkish startup ecosystem has acted by initiating the Coronathon Turkey Initiative with the mission of seeking creative solutions to the problems caused by the virus. Twelve projects were deemed worthy of awards from Coronathon Turkey, which was organized in collaboration with Turkey's leading entrepreneurs, universities, nongovernmental organizations, ministries and private companies with the mission of creating solutions for the problems caused by the coronavirus outbreak.



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Compiled in 2022