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India's State of Science: India's Performance on Key Science & Technology (S&T) Output Indicators

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Out of the *277 indicators* used by the five globally recognised *STI indices*, our study identifies *9 key S&T output indicators* that India should prioritise.

Our study assess this aggregate of output indicators which will be crucial for enhancing India's progress towards becoming one of the *top 3 S&T nations* globally.

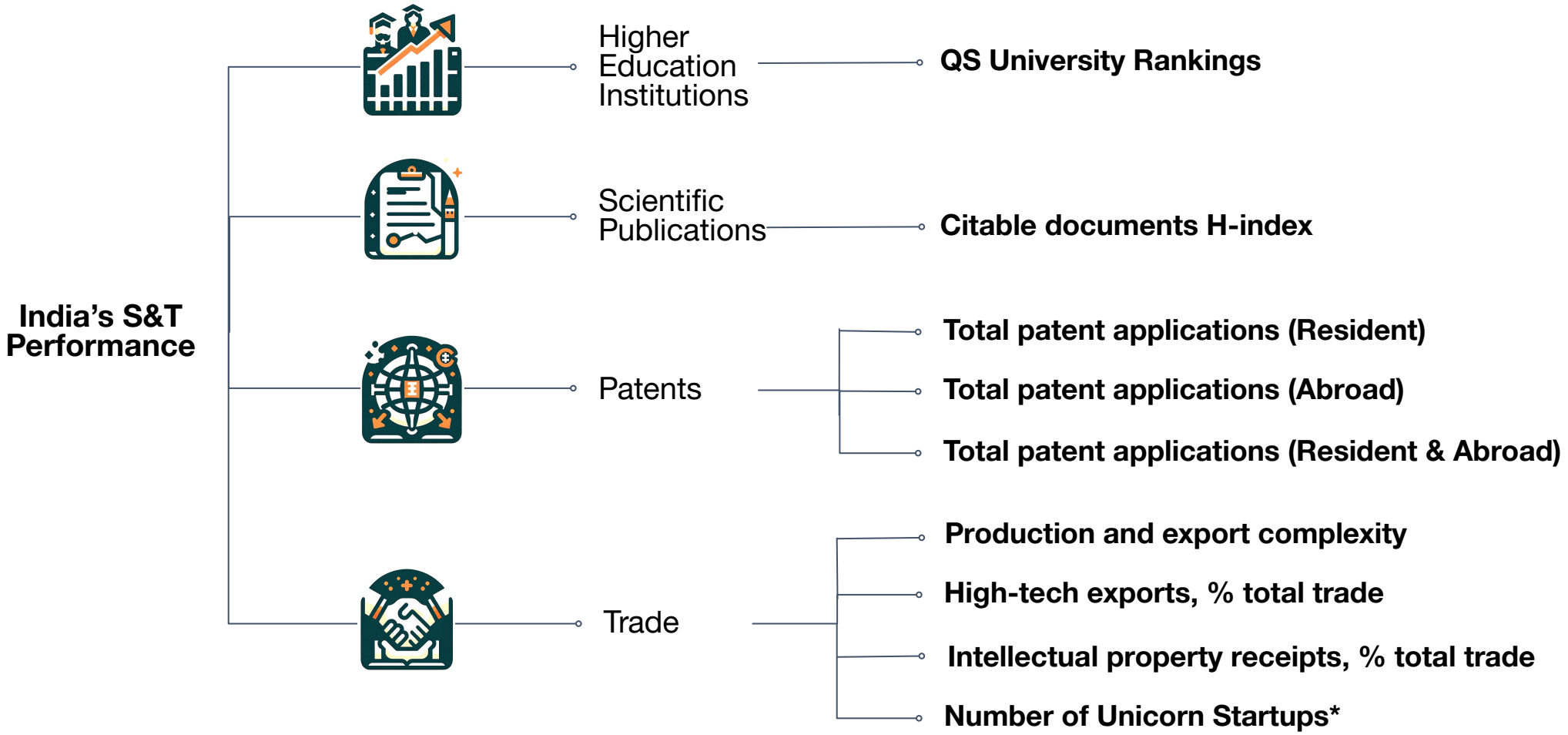
Key takeaways

- India fares better in institutional ranking and publications as compared to translational indicators, including patents and trade related indicators when compared with US and China.
- While India doesn't have a massive difference to the US when it comes to *QS University Rankings* and *Citable documents H-index* Scores (**2.2x** and **3.6x** respectively), there is a significant gap in trade related indicators such as Intellectual property receipts, % of total trade and the number of unicorn startups (**21.5x** and **9.2x** respectively).
- India has improved its rank in patent related indicators from 2019 to 2022, with its *Total Patent Applications (Resident + Abroad)* improving from **12** to **9**.
- In general, India has shown improvement in most indicators studied from 2019 to 2023. The two improvements where India's rank has gotten worse in this period are *Production and Export Complexity* and *QS University Rankings*.

Navigate

India’s Performance on the Nine Key S&T Output Indicators

Selected Nine S&T Output Indicators for India



Note: *Adapted from the Indian Innovation Index, the rest of the indicators are adapted from the Global Innovation Index.

Where does India stand vis-à-vis US and China? (1/2)

Output indicators (2022)	India	US	China	US vs. India	China vs. India
QS University Rankings (Score)	46.0	98.9	86.8	**2.2x**	**1.8x**
Citable documents H-index	858	3051	1333	**3.6x**	**1.5x**
Total patent applications (Residents)	38,551	252,316	1,464,605	**6.5x**	**38x**
Total patent applications (Abroad)	38,517	342,024	154,663	**8.9x**	**4x**
Total patent applications (Residents & Abroad)	77,068	594,340	1,619,268	**7.7x**	**21x**
Production and export complexity	52.4	78.4	73.2	**1.5x**	**1.4x**
High-tech exports, % total trade	4.4	9.4	32.4	**2.1x**	**7.4x**
Intellectual property receipts, % total trade	0.2	4.3	0.3	**21.5x**	**1.5x**
Number of Unicorn Startups	68	625	312	**9.2x**	**4.6x**

Legend:	0x-4x	4x-8x	8x and above

Where does India stand vis-à-vis US and China? (2/2)

Higher Education Institutions

- US and China had better scores for HEIs—**2.2x** and **1.8x** of Indian HEIs respectively

Scientific Publication

- US has the highest citable documents H-index—**3.6x** of India's and **2.3x** of China's

Patents

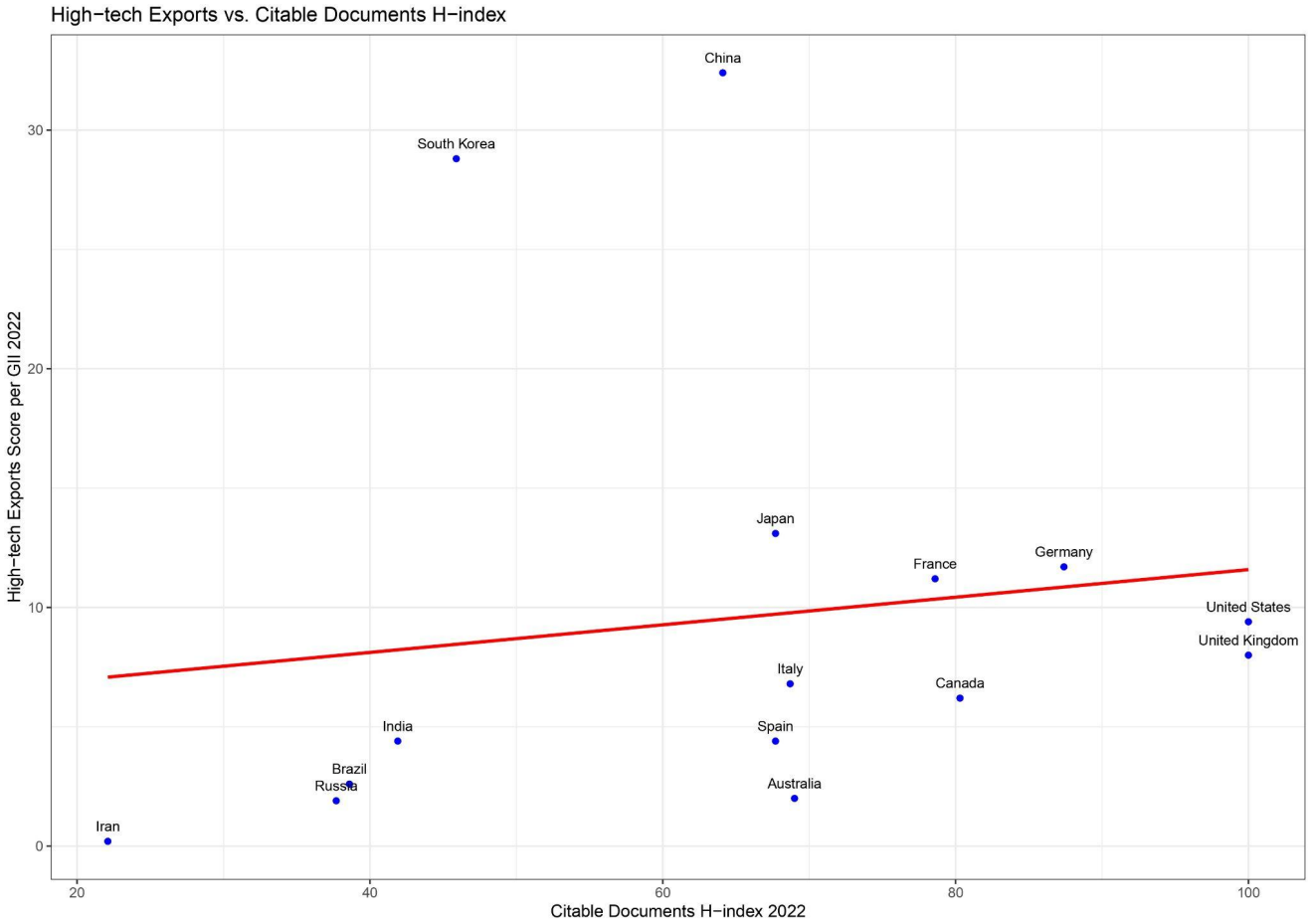
- China's patent applications (Residents) is **38x** of India's count
- On total patent applications (Residents and Abroad), China is **21x** India's number

Trade

- On intellectual property receipts as a % of total trade, US is **21.5x** of India's
- Number of unicorn startups, US is **9.2x** and China is **4.6x** of India
- On high-tech exports, China has the most significant lead, with **7.4x** of India's

The Translation of Research: Science & Engineering (S&E) Research vs. High-Tech Exports

- **China** and **South Korea** stand out as outliers, indicating that these countries may be leveraging their technological advancements effectively in exports despite not having the highest research impact.
- **Germany**'s position indicates that it has a strong research foundation and is also successful in translating this into high-tech exports.
- The **US** and the **UK**'s position indicates highest research impact and substantial high-tech exports.



India's Rank* on Nine Key S&T Output Indicators YOY

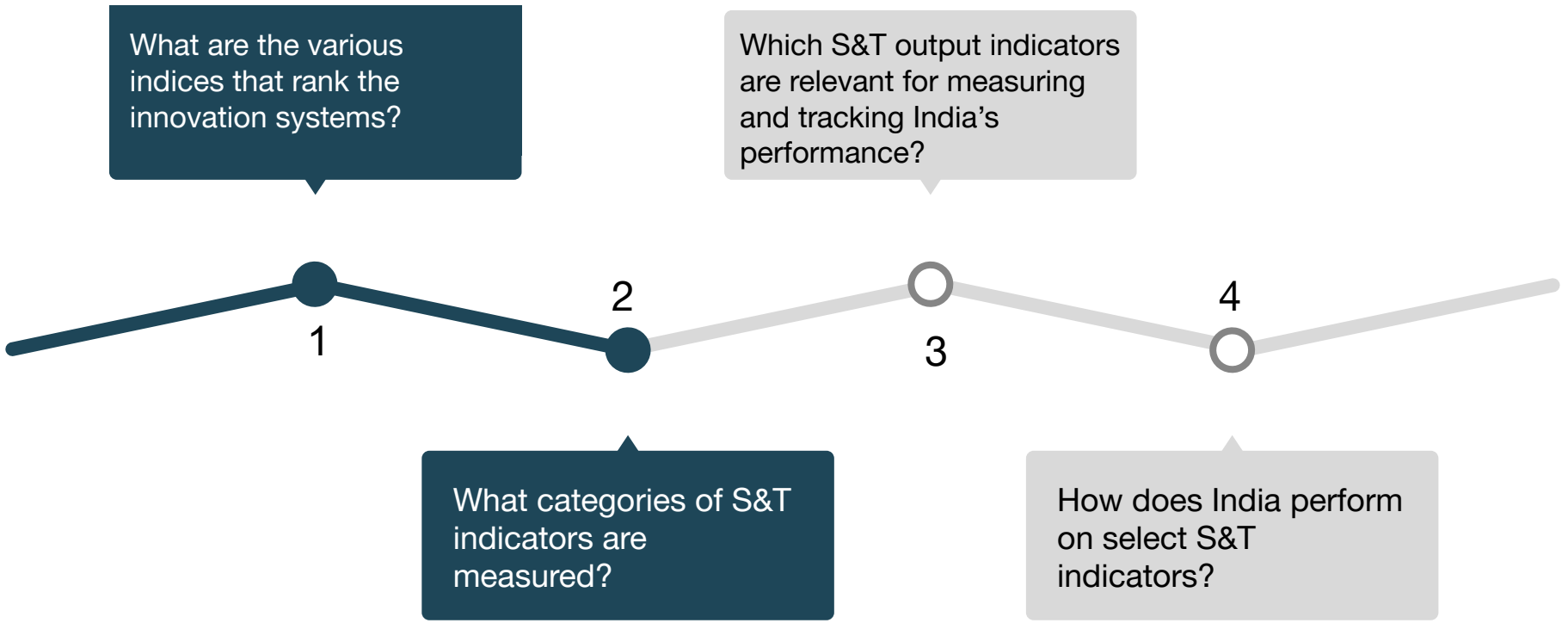
Output Indicators	2019	2020	2021	2022	2023
QS University Rankings	21	22	23	24	22
Citable documents H-index	21	21	21	21	20
Total patent applications (Residents)	9	8	8	6	NA
Total patent applications (Abroad)	14	14	13	13	NA
Total patent applications (Residents & Abroad)	12	10	9	9	NA
Production and export complexity	NA	NA	42	43	46
High-tech exports, % total trade	46	42	39	39	41
Intellectual property receipts, % total trade	50	50	46	46	45
Number of Unicorn Startups	3	4	3	3	3

Legend:		Rank Improvement		Rank Fall		No Change in Rank

Sources: *Ranks as per WIPO Statistics, GII reports, Clarivate, Newspaper Articles, NA as there is no data available for 2023 from the source at the time of collating the data

Methodology

Questions


What are the various indices that rank the innovation systems?
Which S&T output indicators are relevant for measuring and tracking India's performance?
1
2
3
4
What categories of S&T indicators are measured?
How does India perform on select S&T indicators?

Science, Technology and Innovation Measurement Indices





	Global Innovation Index	India Innovation Index	European Innovation Scoreboard	NSF/Science & Engineering Indicators	DST/S&T Report
Type of ranking	Global	Sub-national in India	Between EU Countries & selected countries	Sub-national in US	National statistics in India
Number of indicators measured (Approx.)	80	66	32	60	39
Objective	Capturing innovation ecosystem of global economies	Analysis of the state of innovation in the Indian economy	Comparative assessment of the research and innovation performance	State indicators data tool presents findings on state trends in S&T	Not expressly stated

Note: The study includes only those indices that report measurable innovation, leaving those reporting perceived innovation such as American, Swedish, Norwegian Innovation Index.

Method for Identifying the S&T Indicators

Step—I: Out of the 277 indicators used by the five S&T indices, 66 output indicators were identified.

Step—II: The output indicators were then categorised by us as follows:

a. Intellectual Property
b. Scientific Literature
c. Trade
d. Technology
e. Labour
f. Innovation
g. Knowledge

Step—III: Since the indicators for technology, labour, innovation and knowledge categories represented primarily business related activities, these were discarded. For other categories, representative indicators were chosen based on their data availability.

- GII considers S&T institutions rankings as an input criteria, which is considered as an output indicator for this study

Defining S&T Output Indicator Categories

Category	Definition and rationale
Patents	• Intellectual Property (IP) includes intangible properties that are creation of the mind, such as patents, copyrights, trademarks. • Measuring IP, such as patents, help in understanding whether inventions and discoveries with business cases are being produced in the economy.
Scientific Publications	• Scientific publications are articles published in reputed scientific journals, which are indexed in leading databases globally. • Measuring these enable us to understand whether good quality scientific research is being undertaken in the country.
Trade	• Trade indicators quantify the economic value created through the S&T ecosystem. • These include types of products and services exported and imported.
Higher Education Institutions	• Higher Education Institutions (HEIs) include institutions of learning such as universities, professional schools and colleges. • Indicator(s) ranking HEIs act as a surrogate for quality of S&T outputs

Note: For definitions and explanation of indicators under each of the above four categories, please refer to the Appendix

Appendix

Definition of Indicators: Patents

Intellectual Property Indicators	Definition
Total patent applications (Resident)ǂ	Total number of applications filed with an IP office by an applicant residing in the country/region in which that office has jurisdiction
Total patent applications (Abroad)ǂ	Total number of applications filed by a resident of a given country/jurisdiction with a patent office of another country/jurisdiction
Total patent applications (Resident & Abroad)ǂ	Total number of resident and abroad patent applications filed

Note *For more please refer GII Report 2022; ǂFor more please refer WIPO Statistics

Definition of Indicators: Scientific Publications

Scientific Publications Indicators	Definition
Citable documents H-index*	The H-index is the economy's number of published articles (H) that have received at least H citations. The H-index expresses the journal's number of articles (H) that have received at least H citations. It quantifies both journal scientific productivity and scientific impact, and is also applicable to scientists, journals, and so on. The H-index is tabulated from the number of citations received in subsequent years by articles published in a given year, divided by the number of articles published that year.

Note *For more information please refer GII Report 2022; ⚲For more information please refer EIS Method Report

Definition of Indicators: Trade

Trade Indicators	Definition
Production and export complexity*	The Economic Complexity Index, a ranking of countries based on the diversity and complexity of their export basket. It has taken from the Atlas of Economic Complexity, Growth Lab at Harvard University
High-tech exports, % total trade*	High-technology exports as a percentage of total trade
Startups in the state⊟	No. of startups
Intellectual property receipts, % total trade*	Charges for use of intellectual property, i.e., receipts (% total trade, three-year average)

Note *For more please information refer GII Report 2022; ⊟For more information please refer III

Definition of Indicators: S&T Institutes

S&T Institutes Indicators	Definition
QS University Rankings*	Average score of the top three universities per country according to the QS world university ranking

Note *For more information please refer GII Report 2022