Appendix IV - Global Innovation Index science and technology cluster methodology

Since 2016, the Global Innovation Index (GII) has sought to identify science and technology (S&T) clusters using a bottom-up approach. This approach disregards administrative or political borders and instead pinpoints those geographical areas that show a high density of inventors and scientific authors. The resulting clusters often encompass several municipal districts, sub-federal states and sometimes even two or more countries. Two innovation metrics are employed in the compilation of the top 100 GII S&T clusters worldwide: location of inventors listed on published patent applications and authors listed on published scientific articles.

For patents, this method relies on applications under WIPO's Patent Cooperation Treaty (PCT). PCT patents offer a useful basis for analyzing patents globally. The PCT system applies a single set of procedural rules and collects information based on uniform filing standards. This reduces potential biases that could arise from using data collected from multiple national sources. The patents selected were published over the most recent five-year period available, between 2019 and 2023, to minimize the effects of volatility that can occur between years.

To widen the range of innovation included, scientific publications from the Web of Science's Science Citation Index Expanded (SCIE) are incorporated. The SCIE provides detailed coverage of the world's most impactful academic journals. For the analysis presented here, science and technology fields are the focus, while articles from the fields of social sciences and humanities are disregarded. In addition, scientific publications are limited solely to articles of original research. This excludes other published items, such as meeting abstracts, conference summaries or paper briefs. As with PCT filings, the most recent five-year period according to data availability was also used for the SCIE – publication years 2018 to 2022.

The WIPO PCT patent data set consists of approximately 1.3 million patent applications published between 2019 and 2023, containing 4.1 million inventor addresses. For the SCIE, the data set comprises 7.9 million articles published between 2018 and 2022, containing 27 million listed author addresses.

The process for geocoding of addresses for this report is as follows. PCT inventor addresses were geocoded using the Environmental Systems Research Institute (ESRI) ArcGIS World Geocoder service. In cases where the ESRI address matches proved either ambiguous or insufficiently accurate, the city name in the address string was extracted and matched using records in the city-level data set from the GeoNames Gazetteer database. This latter database gives the geolocation of cities around the globe and contains 48,000 geocoded cities. If the extracted city does not match any known city in the GeoNames database, we attempt to geocode just the extracted city string using the World Geocoder service. This same city-matching approach was applied to all SCIE author addresses.

Overall, 98 percent of inventor addresses were geocoded at either the city level or a more accurate level, while 99.6 percent of scientific author addresses were geocoded at the city level. Appendix Table 5 provides a summary of the geocoding results for the top 20 countries, which together account for the majority of inventor and scientific author addresses. As shown in the table, the coverage of geocoded PCT inventor addresses across all 20 countries is above 99 percent. Similarly, coverage of scientific author addresses is also high, above 99% in all but one instance. This marks an improvement in geocoding coverage as compared to previous years.

Two reasons account for this. First there was noticeable improvement in ESRI's World Geocoder service, especially in Japan and Republic of Korea. Second, we made a stronger effort to match addresses that were previously not matched to any geocode through increased utilization of ESRI's geocoder and manual geocoding.

Addresses were clustered by applying the density-based spatial clustering of applications with noise (DBSCAN) algorithm. This algorithm requires predefined radius and density parameters. As in previous years, a radius of 15 km and a density of 4,500 listed inventors/authors was applied. Equal weight was given to inventors and authors by expressing data points as a share of total inventor and author addresses, respectively. Given that the number of scientific articles far exceeds the number of patents, cluster identification based on the raw data points would have resulted in clusters shaped predominantly by the scientific author landscape.

The result was an initial list of 242 clusters. After review, neighboring clusters were merged if the edge of one cluster was within 3–5 km of another and where the co-author/co-inventor relationships were higher than for any other relationship with any other cluster or non-cluster points. A total of 20 clusters met these criteria, with mergers reducing the overall number of clusters identified to 232.

The remaining 232 clusters were then ranked by counting the number of patents and scientific articles in a given cluster. Numbers were aggregated using fractional counting, in which counts reflect the share of a patent's inventors and an article's authors present in a particular cluster. In addition, mirroring the equal weighting approach described above, fractional counts are relative to the total numbers of patents and scientific articles.

To produce an intensity ranking, the European Commission's Global Human Settlement Layer (GHSL) population distribution data were matched geographically to the top 100 clusters identified in the overall ranking. Just as with inventor/author geocoded locations, these population data allowed us to define the total population of a cluster using a bottom up approach. We chose to define a cluster's area as all the space within 0.05 degrees of each inventor/author location. Overlaying the resultant cluster polygons on top of the population data and aggregating all points which lay within each polygon gave a total population estimate for each cluster. The clusters were then ranked by dividing the total S&T share by population.

Due to the increase in geocoding accuracy and coverage, it was necessary to rerun the clustering process for last year's S&T clusters. The above steps were repeated for PCT publication years 2018–2022 and SCIE publication years 2017–2021 to form the 2023 clusters and their corresponding rankings anew. These updated rankings are the basis for the "Rank Change" indicators referred to in the section.

The African clusters were created using a process similar to that used for the overall clusters. Inventor addresses and author affiliations were filtered to include only those within the African continent. We selected the parameters for DBSCAN through multiple iterations, adjusting distance and density values to minimize the number of points clustered that are at extreme distances and maximize the number of points clustered that were close to each other. This process resulted in a distance parameter of 15 km and a density parameter of 300 creating a total of 50 clusters. The African clusters went through the same review process as the overall clusters, where clusters near each other were checked if they met the merging criteria. No clusters were merged

The same distance parameter of 15 km as in the overall clustering was preferred as to both maintain consistency and because many data points are geocoded only at the city level, so a relatively large radius is necessary to accommodate this level of geocoding accuracy. The lower density parameter of 300 for the African clusters, compared to 4,500 for the overall clusters, reflects the expected patent filing and publication rate from the African continent compared to other regions.

Appendix Table 3: Top 100 S&T clusters, 2024

Rank	Cluster name	Economy	PCT app-lications	Scientific pub-lications	Share total PCT filings, %	Share of total pubs, %	Total	Previous rank
1	Tokyo–Yokohama	JP	134,769	117,294	10.5	1.5	11.9	1
2	Shenzhen–Hong Kong–Guangzhou	CN / HK	116,411	175,364	9.0	2.2	11.2	2
3	Beijing	CN	42,490	308,561	3.3	3.9	7.2	4
4	Seoul	KR	67,082	140,385	5.2	1.8	7.0	3
5	Shanghai–Suzhou	CN	38,699	191,074	3.0	2.4	5.4	5
6	San Jose–San Francisco, CA	US	49,299	57,589	3.8	0.7	4.6	6
7	Osaka–Kobe–Kyoto	JP	38,478	52,800	3.0	0.7	3.7	7
8	Boston–Cambridge, MA	US	18,973	76,250	1.5	1.0	2.4	8
9	Nanjing	CN	7,857	125,607	0.6	1.6	2.2	12
10	San Diego, CA	US	24,555	20,292	1.9	0.3	2.2	9
11	New York City, NY	US	13,945	75,727	1.1	1.0	2.0	10
12	Paris	FR	15,648	61,985	1.2	0.8	2.0	11
13	Wuhan	CN	7,403	101,372	0.6	1.3	1.9	13
14	Hangzhou	CN	11,225	72,226	0.9	0.9	1.8	15
15	Nagoya	JP	17,184	21,160	1.3	0.3	1.6	14
16	Los Angeles, CA	US	11,847	43,464	0.9	0.5	1.5	16
17	Daejeon	KR	14,021	26,426	1.1	0.3	1.4	18
18	Xi an	CN	2,018	98,853	0.2	1.2	1.4	19
19	Washington, DC–Baltimore, MD	US	5,897	72,703	0.5	0.9	1.4	17
20	Qingdao	CN	8,442	47,000	0.7	0.6	1.2	23
21	London	GB	6,558	58,419	0.5	0.7	1.2	20
22	Munich	DE	10,697	27,205	0.8	0.3	1.2	21
23	Chengdu	CN	2,331	77,466	0.2	1.0	1.2	24
24	Seattle, WA	US	11,165	19,697	0.9	0.2	1.1	22
25	Taipei–Hsinchu	TW*	3,887	55,401	0.3	0.7	1.0	27
26	Amsterdam–Rotterdam	NL	4,322	52,439	0.3	0.7	1.0	25
27	Cologne	DE	7,024	33,269	0.5	0.4	1.0	26
28	Houston, TX	US	8,066	23,789	0.6	0.3	0.9	28
29	Stuttgart	DE	9,346	14,517	0.7	0.2	0.9	29
30	Tel Aviv–Jerusalem	IL	7,286	24,955	0.6	0.3	0.9	30
31	Moscow	RU	1,946	57,524	0.2	0.7	0.9	31

Appendix Table 3: Top 100 S&T clusters, 2024 – continued

Rank	Cluster name	Economy	PCT app-lications	Scientific pub-lications	Share total PCT filings, %	Share of total pubs, %	Total	Previous rank
32	Changsha	CN	1,256	60,712	0.1	0.8	0.9	37
33	Singapore	SG / MY	5,234	35,784	0.4	0.5	0.9	34
34	Tianjin	CN	1,378	59,459	0.1	0.7	0.9	36
35	Philadelphia, PA	US	5,669	32,941	0.4	0.4	0.9	33
36	Hefei	CN	3,848	44,040	0.3	0.6	0.9	40
37	Chicago, IL	US	5,571	30,658	0.4	0.4	0.8	32
38	Tehran	IR	388	61,774	0.0	0.8	0.8	35
39	Chongqing	CN	1,502	48,120	0.1	0.6	0.7	43
40	Stockholm	SE	6,044	19,682	0.5	0.2	0.7	38
41	Minneapolis, MN	US	6,633	14,869	0.5	0.2	0.7	39
42	Eindhoven	NL	7,893	5,249	0.6	0.1	0.7	41
43	Frankfurt am Main	DE	5,499	18,242	0.4	0.2	0.7	46
44	Sydney	AU	2,747	35,053	0.2	0.4	0.7	44
45	Berlin	DE	3,483	29,903	0.3	0.4	0.6	42
46	Melbourne	AU	2,017	38,564	0.2	0.5	0.6	45
47	Harbin	CN	276	47,569	0.0	0.6	0.6	54
48	Madrid	ES	1,636	39,016	0.1	0.5	0.6	47
49	Jinan	CN	1,601	38,277	0.1	0.5	0.6	56
50	Zürich	CH	3,862	24,162	0.3	0.3	0.6	49
51	Raleigh, NC	US	3,046	28,922	0.2	0.4	0.6	48
52	Milan	IT	2,628	31,473	0.2	0.4	0.6	51
53	Brussels–Antwerp	BE	3,045	27,565	0.2	0.3	0.6	50
54	Toronto, ON	CA	2,827	28,693	0.2	0.4	0.6	52
55	Barcelona	ES	2,341	30,502	0.2	0.4	0.6	53
56	Bengaluru	IN	4,654	16,029	0.4	0.2	0.6	57
57	Copenhagen	DK	3,125	24,936	0.2	0.3	0.6	55
58	Changchun	CN	542	40,289	0.0	0.5	0.5	59
59	Istanbul	TR	2,383	28,135	0.2	0.4	0.5	60
60	Denver, CO	US	3,264	21,608	0.3	0.3	0.5	58
61	Shenyang	CN	689	36,914	0.1	0.5	0.5	63
62	Montréal, QC	CA	2,343	24,753	0.2	0.3	0.5	61
63	Delhi	IN	1,131	31,795	0.1	0.4	0.5	65
64	Heidelberg–Mannheim	DE	3,929	13,411	0.3	0.2	0.5	62
65	Dalian	CN	1,027	30,602	0.1	0.4	0.5	69
66	Cambridge	GB	3,124	17,141	0.2	0.2	0.5	64
67	Rome	IT	981	30,214	0.1	0.4	0.5	67
68	Zhengzhou	CN	743	31,295	0.1	0.4	0.5	73
69	Atlanta, GA	US	1,902	22,741	0.1	0.3	0.4	68
70	Dallas, TX	US	3,459	9,845	0.3	0.1	0.4	70

Appendix Table 3: Top 100 S&T clusters, 2024 – continued

Rank	Cluster name	Economy	PCT app-lications	Scientific pub-lications	Share total PCT filings, %	Share of total pubs, %	Total	Previous rank
71	Helsinki	FI	2,911	13,122	0.2	0.2	0.4	72
72	Xiamen	CN	2,133	17,812	0.2	0.2	0.4	79
73	São Paulo	BR	727	25,214	0.1	0.3	0.4	71
74	Vienna	AT	1,575	19,895	0.1	0.3	0.4	75
75	Nuremberg–Erlangen	DE	3,397	8,287	0.3	0.1	0.4	74
76	Portland, OR	US	3,643	6,566	0.3	0.1	0.4	66
77	Zhenjiang	CN	1,037	21,984	0.1	0.3	0.4	90
78	Oxford	GB	1,595	18,365	0.1	0.2	0.4	77
79	Pittsburgh, PA	US	1,901	16,464	0.1	0.2	0.4	78
80	Lanzhou	CN	235	26,701	0.0	0.3	0.4	88
81	Busan	KR	2,291	13,932	0.2	0.2	0.4	80
82	Chennai	IN	1,199	20,339	0.1	0.3	0.3	84
83	Ann Arbor, MI	US	1,247	19,413	0.1	0.2	0.3	81
84	Mumbai	IN	1,705	16,146	0.1	0.2	0.3	82
85	Fuzhou	CN	585	22,735	0.0	0.3	0.3	96
86	Ankara	TR	897	20,660	0.1	0.3	0.3	87
87	Cincinnati, OH	US	3,029	7,420	0.2	0.1	0.3	76
88	Daegu	KR	1,852	14,667	0.1	0.2	0.3	85
89	Vancouver, BC	CA	1,629	15,816	0.1	0.2	0.3	83
90	Warsaw	PL	474	22,404	0.0	0.3	0.3	89
91	Austin, TX	US	2,479	9,591	0.2	0.1	0.3	91
92	Lyon	FR	2,069	12,030	0.2	0.2	0.3	86
93	Kuala Lumpur	MY	623	20,387	0.0	0.3	0.3	93
94	Nanchang	CN	459	21,353	0.0	0.3	0.3	106
95	Cairo	EG	166	23,062	0.0	0.3	0.3	103
96	Basel	CH / DE / FR	2,642	7,679	0.2	0.1	0.3	95
97	Brisbane	AU	1,047	16,734	0.1	0.2	0.3	92
98	Kunming	CN	387	20,725	0.0	0.3	0.3	113
99	Göteborg	SE	2,103	10,125	0.2	0.1	0.3	98
100	Macao SAR–Zhuhai	CN	3,081	3,917	0.2	0.0	0.3	111

Notes:(a) This column represents the previous year's rankings, which have been adjusted to align with the updated methodology. The codes given in the tables in this appendix are the ISO alpha-2 country codes, with the following addition: TW* = Taiwan, Province of China.

Source: WIPO Statistics Database, April 2024.

Appendix Table 4: Ranking of S&T intensity

Rank per-capita	Cluster name	Economy	Estimated cluster population	PCT applications per capita (a)	Scientific publications per capita (a)	Total S&T share per capita (a)	Rank change (b)
1	Cambridge	GB	489,751	6,379	35,000	0.9	0
2	San Jose–San Francisco, CA	US	6,252,315	7,885	9,211	0.7	0
3	Eindhoven	NL	1,047,358	7,536	5,011	0.6	0
4	Oxford	GB	568,383	2,806	32,312	0.6	0
5	Boston–Cambridge, MA	US	4,251,769	4,462	17,934	0.6	0
6	San Diego, CA	US	3,910,684	6,279	5,189	0.6	1
7	Daejeon	KR	2,744,149	5,109	9,630	0.5	1
8	Ann Arbor, MI	US	659,434	1,891	29,439	0.5	−2
9	Seattle, WA	US	2,518,357	4,434	7,821	0.4	0
10	Munich	DE	2,794,775	3,828	9,734	0.4	1
11	Beijing	CN	19,415,177	2,189	15,893	0.4	3
12	Göteborg	SE	841,281	2,500	12,035	0.3	0
13	Raleigh, NC	US	1,755,703	1,735	16,473	0.3	0
14	Stockholm	SE	2,151,605	2,809	9,148	0.3	1
15	Tokyo–Yokohama	JP	36,304,277	3,712	3,231	0.3	2
16	Copenhagen	DK	1,699,974	1,838	14,669	0.3	0
17	Helsinki	FI	1,234,101	2,359	10,633	0.3	1
18	Zürich	CH	1,952,063	1,979	12,378	0.3	1
19	Basel	CH / DE / FR	1,021,114	2,588	7,521	0.3	1
20	Stuttgart	DE	3,214,610	2,907	4,516	0.3	1
21	Nuremberg–Erlangen	DE	1,354,796	2,507	6,117	0.3	1
22	Seoul	KR	26,388,052	2,542	5,320	0.3	3
23	Qingdao	CN	4,847,000	1,742	9,697	0.3	8
24	Minneapolis, MN	US	2,740,987	2,420	5,425	0.3	−1
25	Pittsburgh, PA	US	1,390,453	1,367	11,840	0.3	−1
26	Nanjing	CN	8,663,248	907	14,499	0.3	2
27	Hangzhou	CN	7,148,142	1,570	10,104	0.2	2
28	Heidelberg–Mannheim	DE	1,996,950	1,968	6,716	0.2	−2
29	Osaka–Kobe–Kyoto	JP	15,801,605	2,435	3,341	0.2	1
30	Shenzhen–Hong Kong–Guangzhou	CN / HK	50,546,829	2,303	3,469	0.2	2
31	Wuhan	CN	8,697,647	851	11,655	0.2	7
32	Xi'an	CN	6,591,384	306	14,997	0.2	4
33	Changsha	CN	4,060,044	309	14,953	0.2	4
34	Washington, DC–Baltimore, MD	US	7,040,225	838	10,327	0.2	0

Appendix Table 4: Ranking of S&T intensity – continued

Rank per-capita	Cluster name	Economy	Estimated cluster population	PCT applications per capita (a)	Scientific publications per capita (a)	Total S&T share per capita (a)	Rank change (b)
35	Cincinnati, OH	US	1,836,936	1,649	4,040	0.2	0
36	Paris	FR	11,224,000	1,394	5,523	0.2	3
37	Nagoya	JP	9,240,326	1,860	2,290	0.2	3
38	Frankfurt am Main	DE	3,805,907	1,445	4,793	0.2	3
39	Denver, CO	US	3,074,200	1,062	7,029	0.2	5
40	Vancouver, BC	CA	1,944,715	838	8,133	0.2	3
41	Philadelphia, PA	US	5,109,012	1,110	6,448	0.2	4
42	Lyon	FR	1,866,169	1,108	6,446	0.2	0
43	Sydney	AU	4,007,620	685	8,747	0.2	3
44	Portland, OR	US	2,237,730	1,628	2,934	0.2	−11
45	Austin, TX	US	1,964,534	1,262	4,882	0.2	4
46	Vienna	AT	2,413,662	653	8,243	0.2	2
47	Houston, TX	US	6,015,423	1,341	3,955	0.2	0
48	Hefei	CN	5,560,163	692	7,921	0.2	15
49	Changchun	CN	3,630,174	149	11,098	0.2	7
50	Atlanta, GA	US	2,867,637	663	7,930	0.2	1
51	Berlin	DE	4,276,247	814	6,993	0.2	−1
52	Chengdu	CN	7,771,586	300	9,968	0.1	7
53	Amsterdam–Rotterdam	NL	7,038,077	614	7,451	0.1	1
54	Melbourne	AU	4,546,212	444	8,483	0.1	−1
55	Jinan	CN	4,297,068	373	8,908	0.1	7
56	Montréal, QC	CA	3,511,027	667	7,050	0.1	−1
57	Brisbane	AU	2,089,547	501	8,008	0.1	−5
58	Brussels–Antwerp	BE	4,277,629	712	6,444	0.1	−1
59	Milan	IT	4,495,551	585	7,001	0.1	−1
60	Dalian	CN	3,555,305	289	8,607	0.1	8
61	Rome	IT	3,505,600	280	8,619	0.1	0
62	Harbin	CN	4,766,680	58	9,979	0.1	7
63	Toronto, ON	CA	4,485,090	630	6,397	0.1	−3
64	Lanzhou	CN	2,762,551	85	9,665	0.1	9
65	New York City, NY	US	16,136,315	864	4,693	0.1	−1
66	Warsaw	PL	2,558,954	185	8,755	0.1	1
67	Shanghai–Suzhou	CN	43,746,897	885	4,368	0.1	10
68	Tel Aviv–Jerusalem	IL	7,251,972	1,005	3,441	0.1	−2
69	Chicago, IL	US	6,776,544	822	4,524	0.1	−4
70	London	GB	10,354,543	633	5,642	0.1	0
71	Los Angeles, CA	US	12,260,563	966	3,545	0.1	0

Appendix Table 4: Ranking of S&T intensity – continued

Rank per-capita	Cluster name	Economy	Estimated cluster population	PCT applications per capita (a)	Scientific publications per capita (a)	Total S&T share per capita (a)	Rank change (b)
72	Daegu	KR	2,837,234	653	5,169	0.1	2
73	Singapore	SG / MY	7,612,760	688	4,701	0.1	5
74	Zhenjiang	CN	3,187,823	325	6,896	0.1	6
75	Barcelona	ES	5,053,684	463	6,036	0.1	0
76	Xiamen	CN	3,577,736	596	4,978	0.1	5
77	Tehran	IR	7,470,203	52	8,269	0.1	−1
78	Tianjin	CN	8,224,608	168	7,229	0.1	7
79	Cologne	DE	9,606,235	731	3,463	0.1	0
80	Madrid	ES	6,443,098	254	6,055	0.1	2
81	Dallas, TX	US	4,198,793	824	2,345	0.1	3
82	Macao SAR–Zhuhai	CN	3,100,328	994	1,263	0.1	n.a.
83	Taipei–Hsinchu	TW*	11,272,371	345	4,915	0.1	3
84	Fuzhou	CN	3,802,578	154	5,979	0.1	5
85	Busan	KR	4,138,551	554	3,366	0.1	2
86	Chongqing	CN	8,598,002	175	5,597	0.1	4
87	Zhengzhou	CN	5,404,356	138	5,791	0.1	4
88	Kunming	CN	3,507,173	110	5,909	0.1	n.a.
89	Shenyang	CN	6,275,156	110	5,883	0.1	−1
90	Nanchang	CN	4,035,084	114	5,292	0.1	n.a.
91	Ankara	TR	5,013,614	179	4,121	0.1	1
92	Moscow	RU	14,081,728	138	4,085	0.1	1
93	Istanbul	TR	12,724,837	187	2,211	0.0	1
94	Bengaluru	IN	14,876,070	313	1,077	0.0	2
95	Kuala Lumpur	MY	8,461,712	74	2,409	0.0	0
96	Chennai	IN	10,869,934	110	1,871	0.0	1
97	São Paulo	BR	18,612,849	39	1,355	0.0	1
98	Delhi	IN	28,845,689	39	1,102	0.0	1
99	Mumbai	IN	21,362,863	80	756	0.0	1
100	Cairo	EG	22,096,805	8	1,044	0.0	n.a.

Notes: (a) Per capita figures refer to 1,000,000 of population. (b) This column represents the previous year's rankings, which have been adjusted to align with the updated methodology. n.a. indicates not applicable. The codes given in the tables in this appendix are the ISO alpha-2 country codes, with the following addition: TW* = Taiwan, Province of China.

Source: WIPO Statistics Database, April 2024.

Appendix Table 5: Summary of geocoding results

	Scientific publications			PCT applications		
Country	Number of addresses	City-level geolocation (%)	Publications covered (%)	Number of addresses	Block-level geolocation (%)	Sub-Cit level geolocat (%)
China	6,846,428	99.9	99.9	1,025,503	84.9	2.6
United States of America	7,272,035	100.0	100.0	960,198	96.4	3.5
Japan	1,361,613	99.6	99.9	533,790	68.6	26.3
Germany	1,608,493	99.9	99.9	268,710	99.0	0.9
Republic of Korea	910,680	99.1	99.5	313,135	99.2	0.6
United Kingdom	1,621,460	99.4	99.6	88,654	54.1	45.6
France	1,173,788	99.1	99.5	106,896	93.8	5.3
Italy	1,395,964	99.9	99.9	47,678	95.0	4.6
India	1,047,506	99.0	99.3	50,617	37.6	60.9
Canada	1,031,392	99.9	99.9	48,766	97.0	2.8
Spain	1,052,056	99.4	99.7	28,297	87.3	12.2
Australia	1,003,923	99.8	99.9	21,331	93.7	5.4
Netherlands	581,502	99.8	99.9	44,609	98.9	0.5
Brazil	782,137	99.8	99.9	10,614	90.9	8.9
Switzerland	392,369	99.7	99.7	42,274	97.8	1.8
Russian Federation	454,048	99.7	99.8	16,063	95.8	3.9
Sweden	339,569	99.9	99.9	44,645	98.8	0.8
Türkiye	468,830	98.8	98.6	16,799	76.4	22.7
Israel	189,988	98.3	99.4	29,194	86.2	9.3
Belgium	287,322	99.8	99.9	19,779	98.1	1.8
World Total	**27,022,686**	**99.6**	**99.9**	**4,113,927**	**85.2**	**7.5**

Note: This list includes the top 20 countries that account for and ordered by the highest combined shares of patents and scientific articles. PCT inventor addresses were geocoded to the highest level of detail. Due to their much larger volume, scientific author addresses were geocoded to the city level only.

Source: WIPO Statistics Database, April 2024.

Appendix Table 6: African S&T clusters

Rank	Cluster name	Economy	PCT app- lications	Scientific pub- lications	Top applicant	Top scientific organization
1	Cairo	EG	168	23,062	Si-Ware Systems	Cairo University
2	Johannesburg	ZA	684	12,814	DETNET South Africa	University of Witwatersrand
3	Cape Town	ZA	296	8,804	Stellenbosch University	University of Cape Town
4	Tunis	TN	27	5,416	Della Toffola	Universite de Carthage
5	Alexandria	EG	27	4,284	Augmania	Alexandria University
6	Durban	ZA	42	3,722	University Of Kwazulu-Natal	University Of Kwazulu Natal
7	Mansoura	EG	7	3,409	Abd Elaal, Nasser Kamal	Mansoura University
8	Sfax	TN	2	3,201	Gargouri, Ahmed	Universite de Sfax
9	Nairobi	KE	23	2,942	IBM	University of Nairobi
10	Zagazig	EG	4	2,945	Abd Elwahab, Khaled, Mohamed	Zagazig University
11	Addis Ababa	ET	2	2,857	Endeshaw, Alexander, Skunder, Bekele	Addis Ababa University
12	Algiers	DZ	19	2,704	Dahmane, Smail	USTHB
13	Rabat	MA	65	2,344	Université Internationale de Rabat	Mohammed V University in Rabat
14	Banha–Shibin El Kom	EG	6	2,581	El-Gazzar, Basim Abd-El-Fattah	Menofia University
15	Asyut	EG	1	2,506	RIKEN	Assiut University
16	Tanta	EG	10	1,938	Elkazaz, Mohamed, Fadly, Abd El Ghany	Tanta University
17	Monastir	TN	7	1,880	Ghidhaoui, Abir	Universite de Monastir
18	Kampala	UG	3	1,901	KOPS	Makerere University
19	Accra	GH	3	1,651	mPedigree Technologies	University of Ghana
20	Casablanca	MA	71	1,204	PSA Automobiles	Hassan II University of Casablanca
21	Yaoundé	CM	4	1,510	Manga, Edouard	University of Yaounde I
22	Bloemfontein	ZA	11	1,386	De Wet, Christoffel Johannes Henze	University of the Free State

Appendix Table 6: African S&T clusters – continued

Rank	Cluster name	Economy	PCT app-lications	Scientific pub-lications	Top applicant	Top scientific organization
23	Beni Suef	EG	1	1,423	Pennsylvania State University	Beni Suef University
24	Marrakesh	MA	10	1,302	Mabrouk, Essaid	Cadi Ayyad University of Marrakech
25	Pietermaritzburg	ZA	9	1,302	Voss, Michael	University Of Kwazulu Natal
26	Ibadan	NG	0	1,312	Purdue University	University of Ibadan
27	Fès	MA	27	1,123	Université Sidi Mohamed Ben Abdellah	Université Sidi Mohamed Ben Abdellah
28	Potchefstroom	ZA	14	1,176	North West University - South Africa	North West University - South Africa
29	Minya	EG	3	1,225	Abd Elmoez, Mohamed, Hasan, Soliman	Minia University
30	Gondar	ET	0	1,173	n.a.	University of Gondar
31	Kafr El-Shaikh	EG	0	1,161	n.a.	Kafrelsheikh University
32	Grahamstown	ZA	4	1,075	Rhodes University	Rhodes University
33	Kumasi	GH	1	1,042	Okoh-Asamoah, Kwame	KNUST
34	Ismailia	EG	2	962	Salama, Ahmed Mostafa Mahmoud	Suez Canal University
35	Port Elizabeth	ZA	20	844	Nelson Mandela University	Nelson Mandela University
36	Dar es Salaam	TZ	0	965	n.a.	MUHAS
37	Nsukka	NG	0	877	n.a.	University of Nigeria
38	Lagos	NG	7	812	Mastercard	University of Lagos
39	Sousse	TN	0	823	n.a.	Universite de Sousse
40	Khartoum	SD	10	738	Abdelmonem, Mohamed Osman	University of Khartoum
41	Dakar	SN	8	678	Coly, Mohidine El Tamame	University Cheikh Anta Diop Dakar
42	Harare	ZW	1	658	MIT	University of Zimbabwe
43	Abuja	NG	1	635	Udeh, Oliver	African University of Science & Tech.
44	Cotonou	BJ	1	612	Djogbenou, Luc	Univ Abomey Calavi

Appendix Table 6: African S&T clusters – continued

Rank	Cluster name	Economy	PCT app-lications	Scientific pub-lications	Top applicant	Top scientific organization
45	Lusaka	ZM	1	587	Kumwenda, Misheck Harris	University of Zambia
46	Kinshasa–Brazzaville	CD / CG	1	522	Kafuti Kanyembo, Dominique-Myrtille	Universite de Kinshasa
47	Abidjan	CI	2	500	Fofana, Mouramane	Univ Felix Houphouet Boigny
48	Ouagadougou	BF	1	497	Maia Africa	Univ Joseph Ki Zerbo
49	Oujda	MA	2	420	Madani, Zakaria	Mohammed First University of Oujda
50	Blantyre	MW	0	415	n.a.	University of Malawi

Note: n.a. indicates not applicable. IBM = International Business Machines, KNUST = Kwame Nkrumah University Science & Technology, KOPS = KAMATA Online Protection Services, MIT = Massachusetts Institute of Technology, MUHAS = Muhimbili University of Health & Allied Sciences, RIKEN = The Institute of Physical and Chemical Research (Japan), USTHB = University Science & Technology Houari Boumediene.

Source: WIPO Statistics Database, April 2024.

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