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FEATURED ANALYSIS - January/February 2010

Accomplished in Technology: Taiwan's Research Upswing

by Christopher King, Editor



Since the early 1990s, Taiwan has steadily increased its output of scientific papers, particularly in the last five years, at a rate exceeding many of its fellow "Asian Tiger" nations. This output is concentrated in specialty areas within engineering, computer science, and materials.

For a detailed examination of research from Taiwan, *Science Watch* turned to the [Thomson Reuters](#)

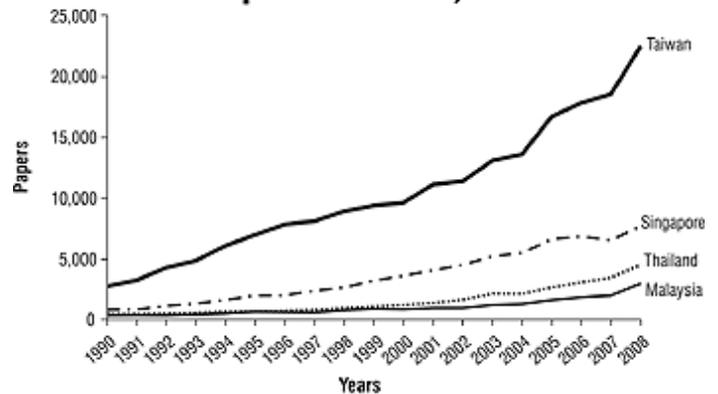
National Science Indicators database, which tracks publication and citation figures for more than 180 nations. The first graph (to the right) displays Taiwan's year-by-year output of papers (all fields) in journals indexed by Thomson Reuters between 1990 and 2008, with comparable figures for Singapore, Thailand, and Malaysia.

More than a decade and a half has elapsed since *Science Watch* scrutinized the Asian Tigers, the comparatively small but economically emergent nations of the Pacific Rim (5[6]: 1-2, June 1994). At that time, based on figures covering 1981 through 1993, Taiwan was predominant in scientific output compared to the nations mentioned above, even surpassing South Korea in 1993 by nearly 2,000 papers.

South Korea, however, was on a tear of its own. As *Science Watch* reported in 2001, South Korea's upward path in output intersected that of Taiwan in 1997 and kept going (12[3]: 1-2, May/June 2001). In recent years, South Korea (although not shown in the accompanying graph) has topped Taiwan by roughly 10,000 papers per year: in 2007, for example, 27,284 papers for South Korea versus Taiwan's count of 18,599.

Still, Taiwan's rise has been impressive. As assessed according to the main fields covered in *National Science Indicators*, the nation's concentration is clearly in the physical sciences. Taiwan's greatest

Taiwan and selected nations, annual output in science, 1990-2008



SOURCE: Thomson Reuters National Science Indicators

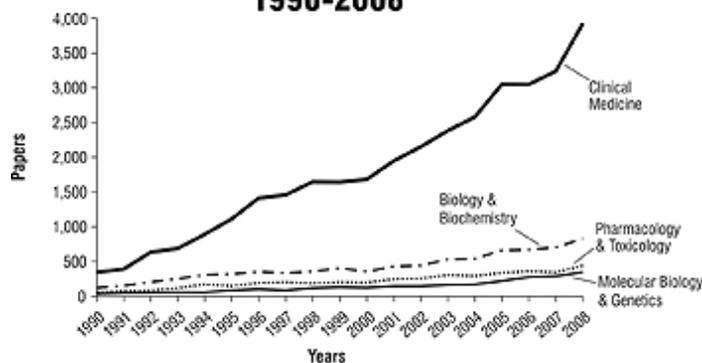
presence in any broad specialty area is in Engineering. In that field, papers listing at least one Taiwan-based institution account for 4.23% of publications indexed by Thomson Reuters between 2004 and 2008. Computer Science is next (3.48% of the field), followed by Materials Science (2.86%) and Physics (2.45%).

For a closer look, *Science Watch* also examined upwards of 250 specific subfields to see where Taiwan's efforts have been concentrated; the results are in the table at the bottom of this page. Atop the list is Engineering: Manufacturing, a field in which Taiwan's 1,670 papers constituted more than 8% of the field for the years 2004 to 2008. Operations Research & Management is next, with Taiwan's representation topping 7% of Thomson Reuters-indexed papers during the five-year period.

Along with assorted sub-specialties of engineering, the table highlights Taiwan's emphasis in computer science and materials. A notable exception is the field of Complementary & Integrative Medicine, in which Taiwan's contribution accounted for nearly 5% of papers. Also on the list is Management, with Taiwan's participation at just over 4% of the field.

Science Watch also sought to assess Taiwan's output in fields outside the physical sciences. The second graph (to the right) tracks the nation's annual number of papers in four main life-sciences fields between 1990 and 2008. Taiwan's output in three of the fields—Biology & Biochemistry, Pharmacology & Toxicology, and Molecular Biology & Genetics—rises modestly in the course of the nearly

Output in four life-sciences fields, 1990-2008



SOURCE: Thomson Reuters National Science Indicators

two-decade period, although only in Biology & Biochemistry does Taiwan's output exceed 500 papers per year. Clinical Medicine, by contrast, rises strikingly, from 350 Thomson Reuters-indexed papers in 1990 to 3,928 in 2008—more than a tenfold increase.

In addition to the steep rise in Clinical Medicine, figures from *National Science Indicators* suggest that the nation is also increasing its presence in other main fields apart from the physical sciences. For example, a comparison of output during two successive five-year periods—1999 to 2003 and 2004 to 2008—indicates that Taiwan's largest increase in number of papers occurred in Psychiatry/Psychology, with a jump of nearly 190% between the two periods. Economics & Business saw a nearly comparable increase, of 178%, and papers in general Social Sciences rose by nearly 170%.

The physical sciences, meanwhile, also feature prominently in the list of Taiwan's fields showing the largest increases in output. Space Science, for example, accounted for Taiwan's fourth-highest rate of increase between the two periods, at 105%. And the nation appears to be consolidating its presence in Computer Science, upping its output by 89%.

The table of Taiwan's particular specialty areas also includes figures comparing the nation's citation impact against the world average for each field. Aside from a couple of exceptions in the listed fields, Taiwan's cites-per-paper figure is below the world average. The same can be seen when one examines each of the main physical-sciences fields in which Taiwan is most concentrated. In Engineering,

Chemistry, Computer Science, and Physics, for example, the country's cites-per-paper mark for the period 2004 to 2008 registered at roughly 80% of the world average. Materials Science, on the other hand, showed comparative strength, with Taiwan's impact score within 5% of the world average during the same period.

Thus, although rising in output, Taiwan still has some progress to make in terms of citation impact.

Nevertheless, as the nation increases its participation in world science and builds on its strengths, impact seems certain to rise commensurately. ■

Christopher King is the Editor of the *Science Watch*® Newsletter, Thomson Reuters.

Taiwan's Research Output by Specialty Area (Ranked by share of world literature, 2004-08)					
Rank	Field	Taiwan world share, 2004-08 (%)	Taiwan # of papers, 2004-08	Taiwan citation impact	World citation impact
1	Engineering: Manufacturing	8.33	1,670	1.23	1.49
2	Operations Research. & Management	7.48	1,895	1.68	1.72
3	Automation & Control	6.65	1,513	1.36	1.78
4	Computer Science: Hardware	6.47	1,845	1.16	1.50
5	Industrial Engineering	6.40	1,066	1.82	1.59
6	Information Systems	6.35	2,176	1.14	1.86
7	Electrical Engineering	6.27	9,807	1.82	2.05
8	Telecommunications	5.81	1,867	1.12	1.50
9	Materials: Coatings & Films	5.47	1,581	2.58	3.17
10	Multidisciplinary Engineering	5.46	1,686	1.44	2.11
11	Electrochemistry	5.25	1,749	3.50	4.74
12	Computer Science: Interdisciplinary	5.02	2,469	1.46	2.65
13	Computer Science: A.I.	4.85	1,938	1.58	1.76
14	Integrative & Complementary Medicine	4.71	241	2.29	2.96
15	Computer Science: Cybernetics	4.30	227	2.11	1.55
16	Nanoscience & Nanotechnology	4.27	2,199	2.85	4.23
17	Applied Physics	4.27	7,590	2.68	3.49
18	Transportation	4.27	155	1.41	2.23
19	Computer Science: Software	4.17	1,053	1.13	1.35
20	Management	4.14	949	1.71	2.54

Source: Thomson Reuters *National Science Indicators*

KEYWORDS: TAIWAN, SCIENCE IN TAIWAN, TAIWANESE SCIENCE, ASIAN TIGERS, SOUTH KOREA, PACIFIC RIM.

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