Research Evaluation of Research-Oriented Universities in Taiwan

Mu-hsuan Huang and Han-wen Chang

mhhuang@ntu.edu.tw, hanwen.chang@gmail.com
Department of Library and Information Sciences,
National Taiwan University, 106, Taipei (Taiwan)

Abstract
This paper uses ISI *Essential Science Indicators* (ESI) database to investigate the academic performance of seven research-oriented universities in Taiwan from both the quantitative and qualitative perspectives. It collects research data for 11 years from 1993 to 2003. The performance indicators applied in this study includes the number of papers, the number of citations, the average citations per paper, the number of highly cited papers, the number of hot papers, and the number of core papers. The research performance and strength of those universities are revealed in this study. It finds that National Taiwan University leads among these seven research-oriented universities. However, individual university still shows strengths in various specific fields.

Introduction

For a long time, bibliometrics based on the number of publications have been used as indicators to evaluate the research capacity and competitiveness of a university. (e.g., Moed et al., 1985) Previously, the number of publications and citations are the most popular indicators. (Nederhof et al., 1993) The number of highly cited papers is also a notable indicator because it is useful to create awareness towards the occurrence of particular articles with great influence. (Aknes & Sivertsen, 2004; Plomp, 1994) Moreover, papers published in specific journal and faculty numbers are also presented. Shanghai Jiao Tong University evaluated the world class universities by alumni and staff of an institution winning Nobel Prizes and Fields Medals and articles published in Nature and Science, etc. (Shanghai Jiao Tong University, 2004) In the study, ranks of the worldwide universities were noticed in academics.

In the light of evaluation effects toward making universities progress, most of previous research evaluations were focused on the universities in a specific area or by a scientific field. (e.g. Kim & Kim, 2000) In 2002, the Ministry of Education in Taiwan also evaluated the research achievements of all Taiwanese universities and selected seven ones to be the key research-oriented universities, including National Taiwan University (NTU), National Tsing Hua University (NTHU), National Chiao Tung University (NCTU), National Central University (NCU), National Yang Ming University (NYMU), National Sun Yat-Sen University (NSYSU) and National Cheng Kung University (NCKU). In this assessment, the number of papers in ISI databases is the most important indicator, while impact and quality of the publications are not considered within it. Therefore, this paper is aimed to use some other indicators to evaluate research performances of these seven universities.

Through ISI *Essential Science Indicator* (ESI) database, this paper evaluates the research performance of the seven research-oriented universities from 1993 to 2003 with the number of papers, the number of citations, the average citations per paper, the number of highly cited papers and the number of hot papers. First, the authors review the overview of the academic publication performance of the seven universities by using the number of papers, the number of citations, and average citations per paper. Secondly, those indicators are considered in the specific fields to evaluate the strengths of these universities. Finally, research quality of these universities is revealed by the number of highly cited papers and hot papers.

Overview of the research performance of the seven universities in academic publications

Table 1 shows the number of papers, citations and the average citations per paper by the universities from 1993 to 2003. NTU performed best with higher the number of papers and citations. It was also

Proceedings of ISSI 2005, pages 247–250.
Edited by P. Ingwersen and B. Larsen.

the only one ranked within global top 100. With comparing these two indicators, the authors find the rank orders of these universities were similar but the range was different. These schools ranked 100-584 by the number of papers but ranked 268-1,199 by citations. Their performances on the number of citations were not as well as on papers.

Also, the impact of their scientific publications was limited during the past eleven years in the world. With the average citations per paper, NTU was no longer the top one. It means that even though NTU was the top in the number of papers and citations, it did not perform as well in the average citation per paper. Similarly, NCKU ranked higher in the number of papers and citations, but lagged to fifth in the rank of average citation per paper.

Table 1. The number of papers, citations and average citations per paper by the universities.

Name of University	Papers (Rank)	Citations (Rank)	Average Citations	Name of University	Papers (Rank)	Citations (Rank	Average Citations
NTU	19,037 (100)	101,728 (268)	5.34	NYMU	4,509 (535)	30,498 (848)	6.76
NCKU	10,220 (254)	40,353 (565)	3.95	NCU	4,222 (551)	17,106 (1,003)	4.05
NTHU	8,433 (315)	37,710 (598)	4.47	NSYSU	3,971 (584)	13,096 (1,199)	3.30
NCTU	7,136 (361)	21,863 (671)	3.06	-	-	-	-

Note: Rank is the institute's global ranking.

The research performance of the seven universities in academic publications by fields

This study also reviews the research performance of the seven research-oriented universities by the fields defined in ESI database. These universities have to meet the citation thresholds of each field, and then were analyzed in this study. Within the 21 specific fields in ESI database (expect multidisciplinary), this paper examines the 13 fields and classifies them into six categories: *Engineering*, *Life Science*, *Social Science*, *Natural Science*, *Agricultural Science*, and *Medical Science*. Research performances of these universities in the fields are revealed as follows.

As Table 2 shows, the seven universities performed best in the category of *Engineering*. All schools performed well in *Engineering* with the exception of NYMU. Among these schools, NTU was the only university ranking in all categories, including *Life Science* and *Social Science*, which no other schools ranked in the two fields. In other words, NTU was the most extensive one since its publications were ranked in the 13 fields and spread out in all six major categories. In contrary, NYMU was the school that made rank in only one field, *Clinical Medicine*. However, it cannot objectively explain why the schools were not ranked in some fields. It needs to take more consideration of the structure and research orientation in these universities, and give a faithful evaluation of them.

The research performance in quality publications by the seven universities

Highly Cited Papers is one of the indicators applied to evaluate the quality publications. Because of its citation threshold of 1%, papers are selected more strictly and restrictedly. As table 3 shows, NTU led with 79 highly cited papers and was far higher than others, while NYMU was the last with 12 highly cited papers. However, with the highly cited rate, NCU was the highest with 0.76%, while NTHU was the lowest with 0.21%.

Another indicator to evaluate quality publications of these schools is *Hot Papers*, whose selection is stricter than that of highly cited papers. Of the papers published in the latest two years, papers that meet the 0.01% citation threshold within the most recent two-month time period are considered *Hot Papers*. (Institute for Scientific Information, Inc., 2002) In table 2, only NTU, NCKU, NCU, and NYMU had a few hot papers. NTU and NCKU had three papers respectively, and NCU and NYMU had one hot paper. It reveals that their papers were not cited immediately and wildly after they were published.

Table 2. The number of papers, citations and average citations per paper in ESI fields by the universities.

Discipline	NTU			NCKU			NTHU			NCTU			NYMU			NCU			NSYSU		
	Paper (Rank)	Citation (Rank)	Average citation	Paper (Rank)	Citation (Rank)	Average citation	Paper (Rank)	Citation (Rank)	Average citation	Paper (Rank)	Citation (Rank)	Average citation	Paper (Rank)	Citation (Rank)	Average citation	Paper (Rank)	Citation (Rank)	Average citation	Paper (Rank)	Citation (Rank)	Average citation
Engineering																					
Computer science	569 (48)	1,092 (109)	1.92	429 (86)	701 (176)	1.63	411 (95)	778 (159)	1.89	966 (16)	1,554 (68)	1.61				271 (173)	521 (244)	1.92			
Engineering	2,543 (29)	6,881 (68)	2.71	2,659 (25)	6,661 (71)	2.51	1,668 (69)	5,091 (119)	3.05	2,261 (38)	6,385 (76)	2.82				962 (180)	3,033 (219)	3.15	843 (207)	2,538 (256)	3.01
Materials science	890 (67)	3,437 (102)	3.86	1,290 (31)	4,307 (75)	3.34	1,099 (45)	3,700 (95)	3.37	532 (145)	2,000 (196)	3.76				320 (370)	1,030 (394)	3.22	308 (284)	874 (436)	2.84
Life Science																					
Biology & Biochemistry	867 (227)	6,260 (430)	7.22																		
Environment/Ecology	614 (69)	2,569 (204)	4.18																		
Social Science																					
Social sciences, General	202 (356)	554 (417)	2.74																		
Natural Science																					
Chemistry	2,822 (44)	16,742 (151)	5.93	1,277 (252)	5,435 (457)	4.26	1,948 (113)	11,160 (252)	5.73	745 (439)	3,887 (581)	5.22							596 (526)	2,884 (708)	4.84
Geosciences	412 (192)	2,168 (294)	5.26																		
Physics	2,239 (133)	9,591 (319)	4.28	1,322 (262)	4,765 (510)	3.6	2,050 (153)	10,098 (309)	4.93	1,966 (164)	6,576 (423)	3.34				1,177 (301)	6,246 (441)	5.31			
Agricultural Science																					
Agricultural sciences	293 (100)	1,280 (130)	4.37																		
Plant & Animal science	1,076 (102)	5,048 (180)	4.69																300 (413)	1,195 (602)	3.98
Medical Science																					
Clinical medicine	4,391 (110)	28,453 (272)	6.48	1,353 (421)	8,355 (656)	6.18							2,517 (236)	15,709 (414)	6.24						
Pharmacology & Toxicology	533 (44)	3,815 (120)	7.16																		
Disciplines in ESI ranking	13			6			5			5			1			4			4		
Ratio of making ESI ranking	91.67%			81.51%			85.09%			90.67%			55.82%			64.66%			51.55%		
The number of categories in ranking (totally 6 categories)	6			3			2			2			1			2			3		
The number of fields in ranking (totally 22 fields)	13			6			5			5			1			4			4		

Note: 1. The table does not include the fields of Microbiology, Molecular biology & Genetics, Economics & Business, Mathematics, Space science, Immunology, Neuroscience & Behavior, and Psychiatry/Psychology.
2. Rank is the institute's global ranking.

Table 3. The number of highly cited papers and hot papers by the universities.

Name of University	Highly Cited Papers	Highly Cited Rate	Hot Papers	Name of University	Highly Cited Papers	Highly Cited Rate	Hot Papers
NTU	79	0.41%	3	NTHU	18	0.21%	0
NCKU	46	0.45%	3	NSYSU	15	0.38%	0
NCU	32	0.76%	1	NYMU	12	0.27%	1
NCTU	24	0.34%	0	-	-	-	-

Note: Highly cited rate is equal to the number of highly cited papers divided by the number of papers.

Conclusion

In this paper, research performance and strength of the seven research-oriented universities in Taiwan are revealed. Overall, NTU leads with much more the number of papers and citations. In terms of the strength of universities, NTU shows it advantages in the most various fields, while others shows strengths in various specific. For example, NCKU performs best in *Engineering* and *Materials Science*; NTHU, and NSYSU are great universities in *Chemistry* and *Physic*; NCTU and NCU is superior in *Computer Science*; and NYMU only focuses on *Clinical Medicine*. The finding implies that each of the universities has its strengths in various specific fields. However, it also reveals that the quantitative performance of these universities' papers is better than their qualitative performance. They should be more actively and internationally in academic research. It is a good point that these schools could start with their strength fields and go launching immediately.

References

Aksnes, D. W. & Sivertsen, G. (2004). The effect of highly cited papers on national citation indicators. *Scientometrics*, 59(2), 213-224.

Institute for Scientific Information, Inc. (2002). Essential Science Indicators v1.0. Retrieved Jan. 5, 2005, from http://www.isinet.com/media/presentrep/tspdf/sem-esi-1-0-0702.pdf

Kim, Mee-Jean & Kim, Byong-Ju. (2000). A bibliometric analysis of publications by the Chemistry Department, Seoul National University, Korea, 1992-1998. *Journal of Information Science*, 26(2). 111-119.

Moed, H., Burger, W., Frankfort, J. & Van Raan, A. (1985). The use of bibliometric data for the measurement of university research performance. Research Policy, 14, 131-149.

Nederhof, A., Meijer, R., Moed, H. & Van Raan, A. (1993). Research performance indicators for university departments: a study of an agricultural university. *Scientometrics*, 27(2), 157-178.

Plomp, R. (1994). The hightly cited papers of professors as an indicator of a research group's scientific performance. *Scientometrics*, 29, 377-393.

Shanghai Jiao Tong University. (2004). Academic Ranking of World Universities 2004. Retrieved Jan. 3, 2005, from http://ed.sjtu.edu.cn/rank/2004/2004main.htm