Canadian University Publications 2006

INTRODUCTION

RE$EARCH Infosource Inc. is the leading source of business intelligence on the research and development (R&D) activities of Canadian companies and post-secondary institutions. Infosource publishes *Canada's Top 50 Research Universities List, Canada's Top 100 Corporate R&D Spenders List* and accompanying in-depth reports. (See www.researchinfosource.com for details.) Canadian University Publications (CUP) is our newest effort to shed light on the Canadian R&D scene. CUP 2006 is the first of a series of annual reports.

Conducting research that will advance society's knowledge base is an important role of higher education institutions. Research that appears in peer-reviewed academic journals adds to society's stock of "codified knowledge" and becomes a building block for future progress.

In fiscal year 2004 governments, companies, foundations, private not-for-profit organizations and individuals entrusted over $5 billion to Canadian universities, excluding the salaries of professors, to conduct research in nearly every field of study[1]. Thus society has a significant stake in the research activities of the higher education sector.

CUP analyzes the publication activities of all full-time faculty at 69 universities and their affiliated research hospitals during the 6-year period 1999-2004. In addition, CUP puts Canada's scientific publishing record in an international context, comparing Canada's publishing output with that of other countries, on a variety of measures. CUP combines information about academic publishing with corresponding information on research funding, in order to explore the relationship between research funding inputs and publishing outputs.

The main focus of CUP is the overall performance of the higher education research system. Yet, the report provides sufficient information for individual university assessment. The report concentrates on national publishing and financing trends. It also introduces a number of new indicators that can advance understanding of the dynamics of higher education research funding and performance.

CUP utilizes publication data provided by *l'Observatoire des sciences et des technologies* (OST) at the Université du Québec à Montréal. The Observatoire constructs and maintains the Canadian Bibliometric Database (CBD)™ using the Science Citation Index, Social Sciences Citation Index and the Arts and Humanities Citation Index databases from Thomson Scientific. The CBD lists publications by Canadian researchers according to discipline, institution, collaborative partners, etc. In addition, CUP utilizes RE$EARCH Infosource Inc.'s *Canadian Universities Database*, which

[1]Canada's Top Research Universities Report 2005. RE$EARCH Infosource Inc.

tracks the research income of universities, and faculty data from Statistics Canada. (For a detailed review of the Method, see Section 2.) International comparisons utilize data from the US National Science Foundation.

Research is only one of several important roles that universities play, and publication analysis is only one measure of the performance of the research system. The core function of universities is teaching students, and society gains most from an educated population that can develop and apply new ideas in all spheres of endeavour. Research training can enrich the educational experience and provide new skills and perspectives. An ancillary benefit of research is that it may produce new and useful ideas or technologies that will yield economic or social benefits. Community service is a third important role that universities play. Research, teaching and community service are all taken into account in universities' faculty promotion and tenure decisions. Publication success is an important indicator of research accomplishment, but it is by no means the paramount measure of the performance of our universities.

Interpreting Publication Data

CUP 2006 compiles and analyzes information about Canadian university and affiliated hospital researchers' publishing success in approximately 6,000 leading international peer-reviewed journals covering the Natural Sciences, Health Sciences, Social Sciences and Humanities during the period 1999-2004. CUP also puts Canada's performance in an international context.

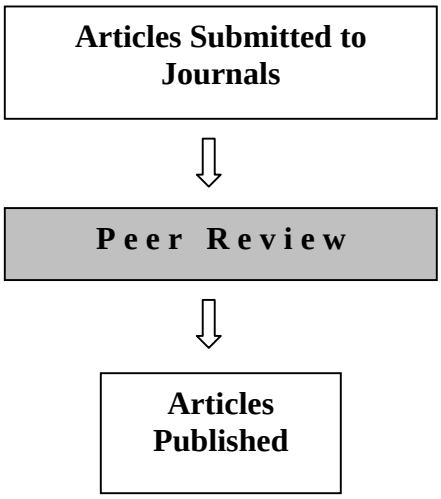
CUP is a record of the publications[2] that were accepted for publication in a set of the world's leading journals and that subsequently appeared in print. It is important to consider that the number of articles accepted for publication in any particular journal represents only a fraction of the articles submitted. As such, one can distinguish between the number of articles that were submitted (written) and those that were published. Depending on the individual journal, acceptance rates can be very low indeed. Thus CUP tracks only published articles, which is undoubtedly just a fraction of those that were written and submitted for publication. Canadian university and hospital researchers undoubtedly authored many more articles in any given year than are indicated in CUP.

Each year there is a finite limit to the number of articles that will be published worldwide in academic journals. The limit is determined by the number of existing publications times the number of pages printed. Data are available on the number of journals catalogued in each of the years that are included in CUP, ranging from 6,112 in 1999 to 5,992 in 2004:

Year	Number of Journals
1999	6,112
2000	6,191
2001	6,069
2002	6,069
2003	6,025
2004	5,992

[2] "Publications" includes articles, notes and reviews.

Publishers, when choosing from the multitude of articles submitted, must rely on the peer review process where (often) anonymous reviewers render an opinion about the quality of articles submitted by researchers and whether they merit being published. On balance, the best of the articles are published, up to the available page limit. So, authors must compete with one another for the available space. Since available space is fixed at any point in time, and the total number of articles submitted for publication worldwide is increasing, then the chance of an individual article being published will diminish.



Although journal counts were comparatively stable during the 6-year period 1999-2004, there was a large growth in "publication space" in the longer period 1988-2003. Some of the expansion occurred because new journals were published and some because existing journals expanded their space. According to the US National Science Foundation, the volume of published material expanded considerably between 1988-2003:

> *"The number of scientific articles cataloged in the internationally recognized peer-reviewed set of S&E journals covered by the* Science Citation Index (SCI) *and* Social Sciences Citation Index (SSCI) *grew from approximately 466,000 in 1988 to nearly 700,000 in 2003, an increase of 50%"*[3]

We know from the available data that countries that previously submitted comparatively few articles – notably China and South Korea – are rapidly increasing their output of scientific articles. Thus worldwide competition for publishing space is growing. In this increasingly competitive environment a country that maintains its published output level may actually be performing rather well. Nevertheless, on balance, few would argue that a nation - or an individual university - will take greater comfort in a growing number of published articles than a declining number.

Strictly speaking, OST categorizes research publications, as opposed to researcher's core discipline. The distinction is subtle but important. The Observatoire's database, which harmonizes the Canadian publication data, classifies the subject of the research and not the specialty (core

[3] Science and Engineering Indicators 2006. Chapter 5. National Science Foundation.

discipline) of the researcher. For example, a sociologist can publish an article (say on *Social order in a retirement home*) in a journal of gerontology and in turn, the OST database will count the article as a Health Sciences publication. There will be a tendency when examining the results in any particular field (e.g. Health Sciences) or subfield (e.g. Clinical Medicine) to assume that only researchers whose core discipline is Health Science or Clinical Medicine will publish in these journals, but this is clearly not the case.

The publication record of researchers working at Comprehensive universities provides a further illustration of the situation. The data indicate that these researchers publish an inordinately high number of Health Sciences papers compared with their Health Sciences faculty numbers (these universities have no medical school or affiliated teaching hospital). A likely explanation is that researchers in other non-Health Science disciplines - e.g., Sociology, Chemistry, Biochemistry, Psychology, etc. - are publishing in Health Sciences journals. While there is close correspondence between the subject of the publication and the specialty of the researchers most of the time, this is not universal and account should be taken of the distinction. For this reason and others, CUP makes no attempt to develop performance indicators at the discipline (department) level, but does provide raw data for readers who choose to do their own calculations.

New Indicators

CUP 2006 introduces two new indicators that we hope will shed additional light on the performance of the university research system. **Publication efficiency** measures how well researchers at different institutions translate the research funding they receive into publication outputs. Publication efficiency posits that if over time two similar institutions receive the same amount of money for research and Institution A produces (say) 50 publications and Institution B produces 100 publications, then Institution B is deemed to be more efficient.

Clearly, certain provisos apply to this indicator. First, the two institutions need to be similar. It is not appropriate, for example, to compare a Medical/Doctoral university (with a medical school, affiliated teaching hospitals and a full range of professional and Ph.D. programs) with an undergraduate university (with no medical school and a limited range of undergraduate and graduate programs). A second proviso is that publication efficiency is best measured over time as research funding inputs can vary from one year to the next, which will skew the data and make single-year comparisons less desirable.

The second new indicator is **Publication effectiveness**. Publication effectiveness combines quantitative and qualitative indicators. The underlying philosophy is that if two similar institutions receive similar amounts of money for research and researchers at Institution A consistently produce high impact (high quality) publications at low cost, and researchers at Institution B consistently produce low impact publications at high cost, then Institution A can be deemed to be more effective than Institution B. CUP has calculated the publication effectiveness of all universities, based on their relative publication efficiency (cost) and publication impact (quality) advantages in relation to those of similar institutions. Where universities have small amounts of research income or low numbers of publications the data can be misleading. So, it is advisable when reviewing individual

university rankings to review the raw data to be sure that they are sufficiently robust to support a firm conclusion.

