

CWTS Graduate Course in Science and Technology Studies

October 6-10, 2008

Measuring Science:

Assessment of Research Performance and Discovery of Patterns of Scientific and Technological Development

Center for Science and Technology Studies (CWTS), Leiden University, Leiden, Netherlands



Short Summary:

GRADUATE COURSE 'MEASURING SCIENCE' 2008

Leiden, October 6-10, 2008

The aim of the course is to provide a serious grounding in all aspects of quantitative analysis of science and technology. The emphasis will be on understanding in depth the various bibliometric and patent analysis approaches. It is intended that each approach should be understood within the overall context of the present development of science and technology and particularly of knowledge communication practices in science.

The course is directed by Professor Anthony van Raan, Director of the Center for Science and Technology Studies (CWTS), Leiden University. With him, Dr Henk Moed, Dr Robert Tijssen, Dr Ed Noyons, Dr Thed van Leeuwen, all CWTS senior staff members, will be the main course tutors. There will be plenty of time for their thorough presentations and for discussion after the presentations. Also two practical exercises will be part of the course.

The course is designed as a general, interdisciplinary part of the Leiden University Master of Science (M.Sc.) programs in a very wide range of disciplines, particularly in the natural sciences, the bio-medical fields, economics, social and behavioral sciences. The level is at the last year of the M.Sc., but also Ph.D. students in all fields of science with a strong interest in quantitative aspects of modern science and technology will benefit from the course.

The course is also intended for a special group of participants: professionals whose work is closely related to science and technology: government and research organization officials, research institution staff, industrial R&D managers, and scientists and engineers who are involved in science policy, research management, and research evaluation procedures.

1. Introduction

The international course on quantitative studies of science, with a focus on advanced bibliometric methods, will be organized from **October 6** (Monday) to **October 10** (Friday) **2008**. The course fee is (*non-student* participants) € **1,800**, including tuition, course notes, a textbook, lunches, coffee and tea breaks, dinner. Hotel accommodation is *not* included. No course fee for Leiden MSc students; the course is 2 ECTS points. For PhD students we apply the reduced fee (excl. the text book) of € 630. MSc and PhD students can obtain the textbook against reduced price.

Dates and Location:

The lecture course will be given from Monday 6 October to Friday (morning) 10 October 2008 by the Center for Science and Technology Studies (CWTS), Leiden University, Leiden, The Netherlands. The course location will be announced on our website (July 2008).

Application:

An application form will be available on our website (July 2008). You can already pre-register by contacting the course office: Mirella Imthorn, MMH.IMTHORN@ICS.LEIDENUNIV.NL, Events & Public Relations Office, Leiden University, <http://www.evenementenbureau.leidenuniv.nl/>

Further Information about the content of the course and about CWTS:

See our website: <http://www.socialsciences.leidenuniv.nl/cwts/>

In the final version of this announcement (first week of September) we will include hotel information. You can also contact the course office.

2. Objectives

The course offers lectures and hands-on training by CWTS senior scientists, all experts of an internationally outstanding level in quantitative studies of science and technology. Furthermore, the course provides possibilities for an international exchange of experiences in practical applications.

The aim of the graduate course is to provide:

- *Introduction and overview of methods of measuring science;*
- *Presentation and discussion of conceptual, methodological and technical key issues;*
- *Approaches to the design and use of research performance assessment indicators;*
- *Approaches to the design and use of science maps;*
- *Insight into the economical aspects of science and the characteristics of the science-technology interface based on patent data;*
- *Discussion of new developments such as Ranking of universities, SCOPUS, Google Scholar, Open Access.*

3. Participants

The course is designed as a general, interdisciplinary part of the Leiden University *Master of Science* (M.Sc.) programs in a very wide range of disciplines, particularly in the natural sciences, the bio-medical fields, economics, social and behavioral sciences. The level is at the last year of the M.Sc., but also *Ph.D. students* in all fields of science with a strong interest in quantitative aspects of modern science and technology will benefit from the course.

The course is also intended for a special group of participants: *professionals* whose work is closely related to science and technology: government and research organization officials, research institution staff, industrial R&D managers, and scientists and engineers who are involved in science policy, research management, and research evaluation procedures. Particularly for board members and staff of national and institutional graduate schools the course offers a directly relevant training.

Furthermore, staff of scientific libraries, documentation centers and publishers should attend this course as scientific communication based on publications and particularly the role of journals will be a major topic in this course.

4. Main theme of the Graduate Course

Each year about a million scientific articles are published. How to keep track of all these developments, particularly the relations with other fields? Are there *cognitive structures* 'hidden' in this mass of published knowledge, at a 'meta-level'? Is it possible to discover emerging or converging areas of scientific or technological activity?

This course addresses a quantitative methodology to discover the structure of the scientific 'landscape' in order to gain concrete and detailed insight into the development of fields of science, the transfer of knowledge between research fields, the interaction between science and technology. This methodology is appropriate to visualize the position of research activities in the international 'landscape' in relation to interdisciplinary developments, and particularly in relation to socio-economic problems. It even provides the possibility of foresight. Furthermore, and very important, it allows the identification of the important actors.

This latter point brings us to a further main thematic part of the course. Science is a human endeavor, and it is crucial to know who the important actors are, what research they conduct, and at what level of performance. Research performance assessment is a matter of evaluation. Most of the evaluation work worldwide relies heavily or almost completely on expert panels and other forms of peer review. Undoubtedly, opinions of experts are of crucial importance in evaluation processes. Nevertheless there are severe, often underestimated and even neglected problems in peer review. In this course new developments in the field of quantitative studies of science and technology are presented. These developments offer methods to support peer review in order to keep it objective and transparent.

Therefore, this course will have its benefits for those who are involved in evaluation of research programmes financed by the government, assessments of university research groups, science policy decision making and identification of national strengths and weaknesses. But at the same time it will offer participants a broad and general overview in methods to describe the growth of science and the many aspects of science that can be derived from its principal activity: publication of research results.

5. Course documents, topics

The course language is English. Course material includes lecture notes (PowerPoint handouts), the textbook *Citation Analysis in Research Evaluation* by H.F. Moed (Leiden), published by Springer; background articles and book chapters. Hands-on training will be with 'real-world' data. Course items are:

- Basic ideas, history, ambitions, concepts, assumptions or underlying theories/models
- Data on the scientific enterprise
- Bibliometric analysis as genre within the quantitative studies of science, socio-economic, cultural and political context;
- Publications as codified scientific knowledge: role of literature, and particularly of journals
- Referencing as basic mechanism: the source of citations
- The Science Citation Index / Web of Science as a major invention, the pioneers and their work
- From data to indicators: what is measured, and how: the bibliometric method
- Some first impressions by bulk indicators: role of nations, the skewness of scientific production, changes in the position of developing countries
- From bulk- to context-related indicators
- Main streams: performance measurement, mapping, science and technology interface
- Typical problems in the measurement of science: methodological, technical
- Problem- and question-driven indicator development
- Practical applications of research performance measurement, lessons learnt
- Measures of interdisciplinarity
- Research performance and international collaboration
- Fine-structure measurements: identification of scientific excellence, knowledge users
- Socio-economic and political expectations of science indicators
- Bibliometrics and data-mining: mapping of science
- Practical applications of science maps, lessons learnt
- Patents as codified technological knowledge
- Role of patents in analyzing bridge between science and technology
- Look forward: quantitative study of science and technology in a new perspective
- Alternatives to the Science Citation Index/Web of Science: SCOPUS, Google Scholar, NEC, ArXiv.

Special topics (a selection will be presented, 'capita selecta'):

- Journal Performance Indicators
- Language biases
- Quantitative study of the growth of science and its implications for indicators
- From data to indicators: hands-on experience in measuring research performance
- From data to maps: hands-on experience in using 'second generation' science maps
- Patent citation analysis: interface between science and technology
- Science as a complex system: mathematical models of citation distributions, self-organization and scale-free networks, fragmentation and growth
- Sleeping beauties in science
- How to organize and manage a research evaluation project with bibliometric analysis?
- Possibilities and limitations in measuring the socioeconomic impact of research
- Science and economy: measuring returns on R&D
- Developments around Open Access
- New indicators such as the Hirsch Index
- Ranking of universities

6. Graduate Course Program

(minor changes are possible)

Location: Pieter de la Court Building, Faculty of Social and Behavioral Sciences, Leiden University. *We will indicate lecture room numbers in the final version of the program.*

Monday 6 October 2008

Registration with coffee 8.30-9.00 in front of the Lecture Room

Welcome round and introduction of participants 9.00-9.15

General introduction to the quantitative study of science I

Prof. Anthony van Raan

Main themes: Basic ideas, concepts and assumptions of measuring science; assessment of the contribution to scientific progress and measurement of scientific performance; from data to indicators, and from 'bulk-' to 'context-related' indicators; Web of Science.

9.15-10.00, 10.10-11.00, **coffee break 11.00-11.20**, 11.20-12.05, 12.15-13.00

Lunch 13.00-13.45

General introduction to the quantitative study of science II

Prof. Anthony van Raan

Main themes: 'fine structure measurements', identification of scientific excellence; measurement of knowledge diffusion and interdisciplinarity

13.45-14.30

tea break 14.30-14.50

Citations in journal publications as a basic phenomenon for measuring science

Dr Henk Moed

Main themes: the ISI Citation Indexes: what do they cover, how are journals selected; age distributions of citations and references; differences between fields of science; inaccuracies in citation analysis; citation theories: what do citations measure; types of citation-based indicators.

14.50-15.35

Research performance indicators for social sciences and humanities

Dr Henk Moed

Main themes: Differences among disciplines; target- and source expanded citation analysis; alternative approaches; library catalog analysis.

15.45-16.30

Economics of Science: Introduction

Dr Robert Tijssen

Main themes: how does science affect the economy? What is industrial relevance and economic benefits of public sector science? Includes an overview of basic concepts, notions and definitions for measurement models.

16.45-17.30

CWTS Welcome Reception & Dinner for the external participants 18.00

Tuesday 7 October 2008

Open access, downloads and citations

Dr Henk Moed

Main themes: what is "Open Access"; the effects of Open Access upon citation impact; downloads versus citations.

8.45-9.30

Bibliometric Indicators and Peer Review in Evaluation Procedures

Dr Henk Moed

Main themes: how do bibliometric indicator values and peer judgments correlate, what are the potentials and limitation of indicators in evaluation procedures

9.40-10.25

coffee break 10.25-10.45

The actual use of bibliometric indicators and its effects

Dr Henk Moed

Main themes: The effect of the use of bibliometric indicators upon authors and journal editors; impact factor engineering; UK Research Assessment Exercises; bibliometric indicators and funding parameters.

10.45-11.30

Web of Science, Scopus and Google Scholar

Dr Henk Moed

Main themes: Differences in coverage between Scopus and Web of Science; Potentialities of Scopus for bibliometric studies. Is Google Scholar a useful tool?

11.35-12.20

Lunch 12.30-13.15

Journal Impact Factors

Dr Thed van Leeuwen

Main themes: the ISI journal impact factors, its use and its problems; how to substantially improve journal impact measurement

13.15-14.00

Science Policy Research: An Overview

Prof. Cornelis van Bochove

Main themes: overview of main issues in science policy, national and international aspects, organizational and size characteristics, developments in Europe, Unites States, other developed countries and in developing countries.

14.00-14.45

Tea break 14.45-15.10

Science Policy Research: Focus on Funding Instruments and Research Performance

Prof. Cornelis van Bochove

Main themes: discussion of the various types of funding instruments, national and international differences, expected effects on research performance, need for research based on new data, the benefits of a European university data system.

15.10-16.00

Science and Technology Indicators for National Science Policy

Dr Robert Tijssen

Main themes: building a national 'observatory' for the scientific and technological performance of countries.

16.15-17.00

Discussion and summing up of issues raised today and yesterday

Prof. Anthony van Raan, Dr Henk Moed, Dr Thed van Leeuwen, Prof. Cornelis van Bochove, Dr Robert Tijssen

17.15-17.45

Dinner for the external participants 18.00

Wednesday 8 October 2008

Measuring Research Excellence

Dr Robert Tijssen

Main themes: What is 'research excellence'? How to identify and measure?

9.00-10.30

coffee break 10.30-10.50

Making a Landscape of Science: First Principles of Science Mapping

Prof. Anthony van Raan

Main themes: a biological analogy, encoding of publications, basic mathematics of mapping, from publication similarities to landscapes of scientific fields

10.50-11.35, 11.45-12.30

Lunch 12.30-13.30

Practical Applications of Science Maps

Dr Ed Noyons

Main themes: design of a mapping study; delineation of scientific fields; the crucial role of keywords; applications of science maps, lessons learnt;

13.30-14.15, 14.30-15.15

tea break 15.15-15.35

Practical Mapping Exercises

Dr Ed Noyons, Renald Buter MSc

Introduction 15.45-16.00, followed by the practical work 16.00-17.45

Dinner for the external participants 18.00

Thursday 9 October 2008

Questions Concerning the Practical Mapping Exercises

Renald Buter MSc

09.00-09.30

Linkages between Science and Innovation

Dr Robert Tijssen

Main themes: measuring impacts of scientific research on technological development and innovations; examining linkages and knowledge flows between science and technology; knowledge transfer and utilization, knowledge producers and human resources, and knowledge commercialization indicators

09.45-10.30, **coffee break 10.30–10.50**, 10.50-11.45

Discussion and summing up of issues raised today and yesterday

Prof. Anthony van Raan, Dr Robert Tijssen, Renald Buter MSc

11.45-12.30

Lunch 12.30-13.30

Excursion to the Museum Boerhaave (Scientific and Medical Instruments)

Graduate Course Dinner in the old Leiden city centre 19.00

Friday 10 October 2008

Special topics in bibliometric analysis: statistical properties of indicators, worldwide ranking of universities

Prof. Anthony van Raan

9.00-9.45, 9.55-10.40, **coffee break 10.40-11.00**, 11.00-11.30,

Discussion and summing up of issues raised by the course

Prof. Anthony van Raan, Prof. Cornelis van Bochove, Dr Robert Tijssen, Dr Thed van Leeuwen

11.30-12.30

Presentation of certificates to Graduate Course participants

12.30-12.45

Closure and Lunch

12.45