License to Rank

Coimbra Group Annual Meeting
University of Tartu, May 19, 2006

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Center for Science and Technology Studies (CWTS)
Leiden University
If entities (e.g., universities) are measured in any aspect (e.g., research performance), they can and will be ranked by the measured values.

This is a fact of life, so ‘how to live with it’
One Basic Question:

How can we identify top-universities?
6 Research Questions:

1. Research or Teaching?
2. How to Measure Performance?
3. For all universities worldwide?
4. One numerical value?
5. Significance of positions?
6. How many?
The name of the game is competition:

funds, students (MSc, PhD), researchers (post-docs, tenured positions)
but also:
affiliated institutions, business companies,....
So ‘we’ (policy makers, interested public, students, scientists, business managers) need objective information on the reputation/performance of universities

> Will/can this be a decisive ‘market’ factor (yes and no)
Statement 1:

It is all about *high international standing*, and this is mainly based on *world-class research*
Statement 2:
The next important aspects are

- Exemplary knowledge and technology transfer
- Excellent teaching and learning
First and major challenge now:

- Establish as good as possible the research performance in the recent past in quantifiable terms (objectivity, reliability) rather than a vague concept as ‘reputation’
Two methodological approaches:

(1) ‘broader’ peer review > expert survey > reputational assessment (prizes and awards: ‘selected’ peer opinions)

(2) bibliometric indicators > performance and impact measurement

On the department or research program level (1) and (2) are strongly correlated
- broad, general, often large, old, classic universities
- specialized, often smaller, newer universities
New and specialized universities may have a disadvantage in ‘reputation’ but nevertheless may have a good score on bibliometric performance and for old, classical universities there may be the opposite situation:
Established Reputation ≠ Actual Impact

(But often it is =)
Most influential international university research rankings:

Shanghai Jiao Tong University  (60% bibliom.)
Times Higher Education Supplement  (20% bibliom.)
CHE  (bibliom ^)

and further:
The Scientist, Webometrics, ....
EC-ASSIST Project
(CWTS team: Henk Moed, Thed van Leeuwen, Robert Tijssen, Clara Calero, Ton van Raan)

- All universities world-wide with > 5,000 WoS publications in 1997-2004 (625/y, Europe 350/y);
- this implies the about 1,100 ‘largest’ universities in the world;
- in each of these universities at least 600 active researchers
Expert Survey Problems: (methodological)

1. Biases: geographical, field-specific
2. Responding > Non-responding characteristics
3. Sample size > reliability of measurement
4. Nomination procedure
5. Scaling procedure
6. Controlling variables
7. Standard deviation scores
8. Statistical significance
9. Effect of fake-institutions
-peer/expert review is a slow indicator;
-popularization/media-stars (e.g., Stephen Gould) may considerably affect expert opinions
Bibliometric Principle:

- Researchers in universities produce knowledge;
- This new knowledge is mostly communicated by research papers in the open, international, serial literature;
- Other researchers criticize/use/apply this published work by referring to it in their researcher papers
Not covered by bibliometric measurement are important academic achievements such as the level of teaching, research training, knowledge transfer and technological innovation....
Not covered by bibliometric assessment are other evidences of research performance such as prizes and awards, peer/expert review/surveys, invitations as key-note speakers, etc.

However, in many cases these ‘non-bibliometric’ indicators do correlate strongly with bibliometric indicators
From Beautiful Old Traditions and Highly Reputed Grand Old Men Toward The Front of Science of Today…..

Construction of Advanced Bibliometric Research Performance Indicators
files leading, possibly, to different dynamics, e.g., for the initiation and spread of epidemics.

In the context of network growth, the impossibility of knowing the degrees of all the nodes comprising the network due to the filtering process—
and, hence, the inability to make the optimal, rational, choice—is not altogether unlike the “bounded rationality” concept of Simon [17].

Remarkably, it appears that, for the description of WWW growth, the preferential attachment mechanism, originally proposed by Simon [10],
must be modified along the lines of another concept also introduced by him—bounded rationality [17].

We thank R. Albert, P. Ball, A.-L. Barabási, M. Buchanan, J. Camacho, and R. Guimerà for stimulating discussions and helpful suggestions. We are especially grateful to R. Kumar for sharing his data. We thank NHB/NICRR (P41 RR13622) and NSF for support.

[13] We consider a modification to the network growth rule described earlier in the paper: at each time step t, the new node establishes m new
links, where m is drawn from a power law distribution with exponent gout.
[14] For m(t) = const, one recovers the scale-free model of Ref. [9].
[15] It is known [11] that, for an exponential or fat-tailed distribution of fitness, the structure of the network becomes much more complex; in particular, the in-degree distribution is no longer a power law. Hence, we do not consider in this manuscript other shapes of the fitness distribution.
Book chapters
Reports
Books
Conf. Proceed.
Journal articles

.... and also field-specific!
Research group

CPP\_(\text{group})

CPP\_(j) = JCS
CPP\_(f) = FCS

Whole world, relevant journals and/or relevant field(s)
Research performance

very good  $CPP/FCSm > 2$

excellent  $CPP/FCSm > 3$
Technical Problem 1:

- delineation, definition & unification of research institutions particularly universities with their academic hospitals

This is a specific responsibility: here CWTS has a unique selling point
Technical Problem 2:

- citing-cited mismatches
CWTS solved this problem to a very large extent and considerably improved the WoS datasystem
Methodological Problems:
- Field definition
- Field-normalization of citation counts
- Black box indicators (do not use)
- ISI Impact factors (do not use)
- Highly cited scientists (do not use) > highly cited articles
- Article-type normalization of citation counts
- US bias
- Language bias (Germany: 25%!)
- Engineering, Social Sciences, Humanities
- Same data, same methodology, different rankings
FIGURE 1:
TREND IN IMPACT PER PUBLICATION COMPARED TO WORLD SUBFIELD AVERAGE

CPP/FCSm

MDC as a whole

world average

1992 - 1996
1993 - 1997
1995 - 1999
1996 - 2000

0.0
0.5
1.0
2.0
2.5
Output share of types of scientific co-operation

International Cooperation
National Cooperation
Single Group
Within Institute

% output

1990 - 1994
1991 - 1995
1992 - 1996
1993 - 1997
1994 - 1998
1995 - 1999
1996 - 2000
1997 - 2001

% output
Impact of types of scientific co-operation

<table>
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<th>CPP/FCSm</th>
<th>0.80</th>
<th>1.00</th>
<th>1.20</th>
<th>1.40</th>
<th>1.60</th>
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<th>2.00</th>
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<td>1992 - 1996</td>
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<tr>
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<td>1994 - 1998</td>
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<tr>
<td>1995 - 1999</td>
<td></td>
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<td>1996 - 2000</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>1997 - 2001</td>
<td></td>
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</tbody>
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- International Cooperation
- National Cooperation
- Single Group
- Within Institute
### Univ. Tartu

<table>
<thead>
<tr>
<th>Year</th>
<th>P</th>
<th>CPP/FCSm</th>
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<tr>
<td>1980</td>
<td>86</td>
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</tr>
<tr>
<td>1990</td>
<td>135</td>
<td>0.63</td>
</tr>
<tr>
<td>2001</td>
<td>386</td>
<td>0.85</td>
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<tr>
<td>2002</td>
<td>404</td>
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</table>

*big improvement!*
Correlation between Expert Scores with Citation-Analysis Based Scores
THE Ranking 2004

\[ y = 53.985x^{0.0397} \]

\[ R^2 = 0.005 \]
Correlation of THES 2005 Europe Ranking with CWTS normalized impact
## Major 33 European Universities with P(y) > 2,000
ranked by normalized impact

<table>
<thead>
<tr>
<th>University</th>
<th>Country</th>
<th>P(y)</th>
<th>Disc Conc</th>
<th>CPP/FCSm</th>
</tr>
</thead>
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<tr>
<td>UNIV OXFORD</td>
<td>UK</td>
<td>4,200</td>
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<td>1.7</td>
</tr>
<tr>
<td>UNIV CAMBRIDGE</td>
<td>UK</td>
<td>4,500</td>
<td>0.31</td>
<td>1.6</td>
</tr>
<tr>
<td>ETH ZURICH</td>
<td>CH</td>
<td>2,300</td>
<td>0.49</td>
<td>1.5</td>
</tr>
<tr>
<td>UNIV EDINBURGH</td>
<td>UK</td>
<td>2,200</td>
<td>0.22</td>
<td>1.5</td>
</tr>
<tr>
<td>UNIV COLL LONDON</td>
<td>UK</td>
<td>4,300</td>
<td>0.36</td>
<td>1.5</td>
</tr>
<tr>
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<td>UK</td>
<td>3,400</td>
<td>0.26</td>
<td>1.4</td>
</tr>
<tr>
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<td>DE</td>
<td>2,000</td>
<td>0.40</td>
<td>1.4</td>
</tr>
<tr>
<td>UNIV HELSINKI</td>
<td>FI</td>
<td>2,600</td>
<td>0.30</td>
<td>1.4</td>
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<tr>
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<td>2,600</td>
<td>0.29</td>
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<tr>
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<td>NL</td>
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<td>0.27</td>
<td>1.3</td>
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<td>0.40</td>
<td>1.3</td>
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<tr>
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<tr>
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<td>FR</td>
<td>2,300</td>
<td>0.61</td>
<td>1.1</td>
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<tr>
<td>HUMBOLDT UNIV BERLIN</td>
<td>DE</td>
<td>2,200</td>
<td>0.34</td>
<td>1.1</td>
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<tr>
<td>UNIV MILANO</td>
<td>IT</td>
<td>2,900</td>
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<tr>
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<td>UNIV WIEN</td>
<td>AT</td>
<td>2,700</td>
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<td>1.0</td>
</tr>
<tr>
<td>UNIV BOLOGNA</td>
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<td>2,000</td>
<td>0.30</td>
<td>1.0</td>
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<tr>
<td>UNIV ROMA SAPIENZA</td>
<td>IT</td>
<td>2,700</td>
<td>0.35</td>
<td>0.9</td>
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</table>
### 252 European Universities with P(y) > 350

**Physics, ranked by ‘brute force’**

<table>
<thead>
<tr>
<th>Country</th>
<th>Institution</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>UNIV CAMBRIDGE</td>
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<td>UNIV ROMA SAPIENZA</td>
<td>4496.956</td>
</tr>
<tr>
<td>UK</td>
<td>UNIV DURHAM</td>
<td>4222.861</td>
</tr>
<tr>
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<td>TECH UNIV MUNCHEN</td>
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</tr>
<tr>
<td>DE</td>
<td>UNIV KARLSRUHE (TH)</td>
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<td>UNIV PARIS VI PIERRE &amp; MARIE CURIE</td>
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<td>PL</td>
<td>WARSAW UNIV</td>
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<tr>
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<td>LUDWIG MAXIMILIANS UNIV MUNCHEN</td>
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<tr>
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<td>JOHANNES GUTENBERG UNIV MAINZ</td>
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<tr>
<td>UK</td>
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<tr>
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<td>UNIV UTRECHT</td>
<td>2195.389</td>
</tr>
</tbody>
</table>
Leiden ranking by normalized impact (CPP/FCSm) and by 'brute force impact' (P*{CPP/FCSm}) as a function of P(cum)

\[ y = -0.0126x + 39.556 \]
\[ R^2 = 0.937 \]

\[ y = -0.0003x + 24.356 \]
\[ R^2 = 0.2625 \]
New Approaches:

- Iteration of Expert Survey focused on top-scientists, e.g., the 4,000 most highly cited (CWTS based) scientists;
- Output-specific analysis engineering fields, social science and humanities
- Field-specific Top-10% bibliometric analysis
Correlation between impact and ranking

Worldwide top-universities in life/biomedical sciences

CPP

r
Outlook:

- Improved ranking procedures will further de-equalize universities and reinforce a scientific elite league
- Excessive evaluation hypes will endanger scientific research
- Balance has to be found by data-system improvement, automation of advanced bibliometric assessment procedures, expert survey
Next to the ‘original goal’: value for politicians, policy makers, interested public, students, scientists,.. what can be learned from these ranking exercises by the ‘targets’ (or: victims?…) of these rankings, the individual universities?
Characteristics of a successful university in a bibliometric approach
Permanent presentation

Egyptians | Greeks and Etruscans | Romans
>50% above, and no field below internat. average
Thank you for your attention