

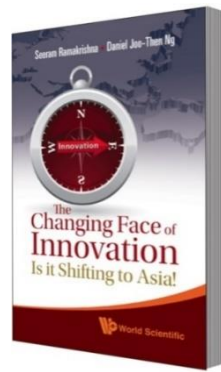
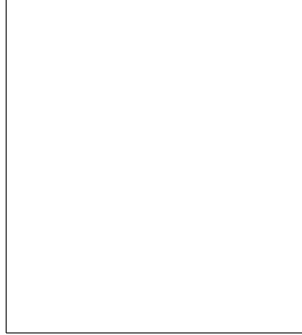


Mobility patterns of scientists and their influence on research performance and institutional prestige

Prof Dr PE Seeram Ramakrishna, *FREng*

National University of Singapore

Co-Founder, University Excellence Care Project (www.uecare.org)



Prof Dr PE Seeram Ramakrishna, *FREng*

seeram.rk@gmail.com

seeram@nus.edu.sg

- Vice-President Research Strategy; Dean, Faculty of Engineering; Director, Center for Nanofibers & Nanotechnology @ National University of Singapore (NUS)
- Founder, Global Engineering Deans Council; and University Excellence Care Project
- Highly cited researcher in Materials Science (highlycited.com). 700 ISI papers; 40,000 citations and 93 H-index. Thomson Reuter identified him among the World's Most Influential Scientific Minds
- PhD, University of Cambridge; The General Management Program, Harvard University
- Fellow, professional societies & academies of Singapore, UK, India, ASEAN & USA

Monday, January 19th, 2015

12:15-13:00 Session: ***Expressing and Measuring of Academic Performance***
[in relation to research]

Chair: **Lucija Čok**, Member of the Council, Slovenian Quality Assurance Agency for Higher Education (NAKVIS), Slovenia

Speaker:

- **Seeram Ramakrishna**, Professor, the National University of Singapore, and Chair of the University Excellence Care Project (UECP):

Mobility patterns of scientists and their influence on research performance and institutional prestige: the University Excellence Care Project (UECP)

Thomson Reuters Web of Science holds ~ 60 million items

~ 15,000 journals

~ 1+ million J papers per year

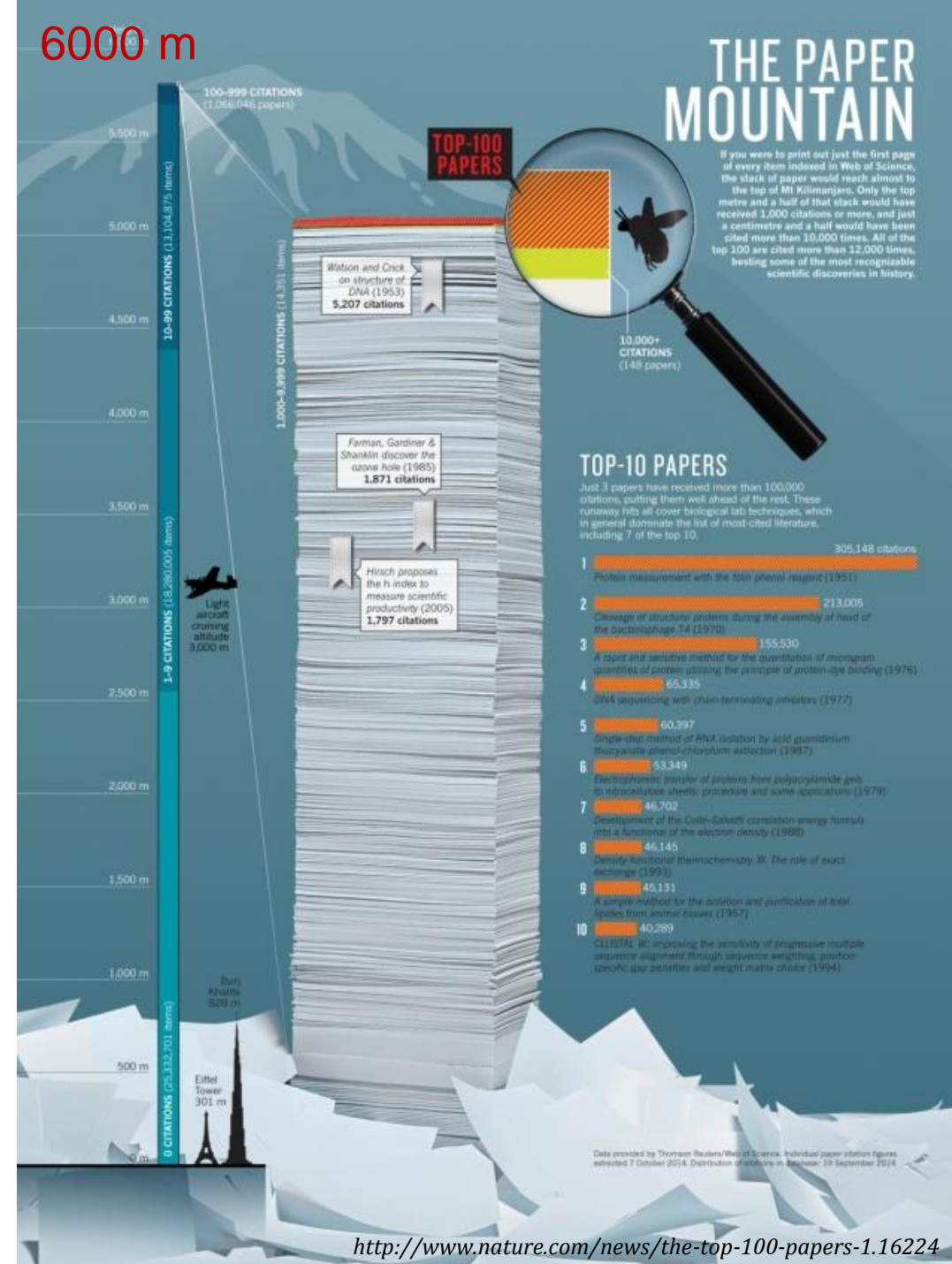
~ 10 million citations per year

~ 5m to 10m in diverse graduate
programs (masters and PhD)

~ Hundreds of disciplinary areas and
specializations

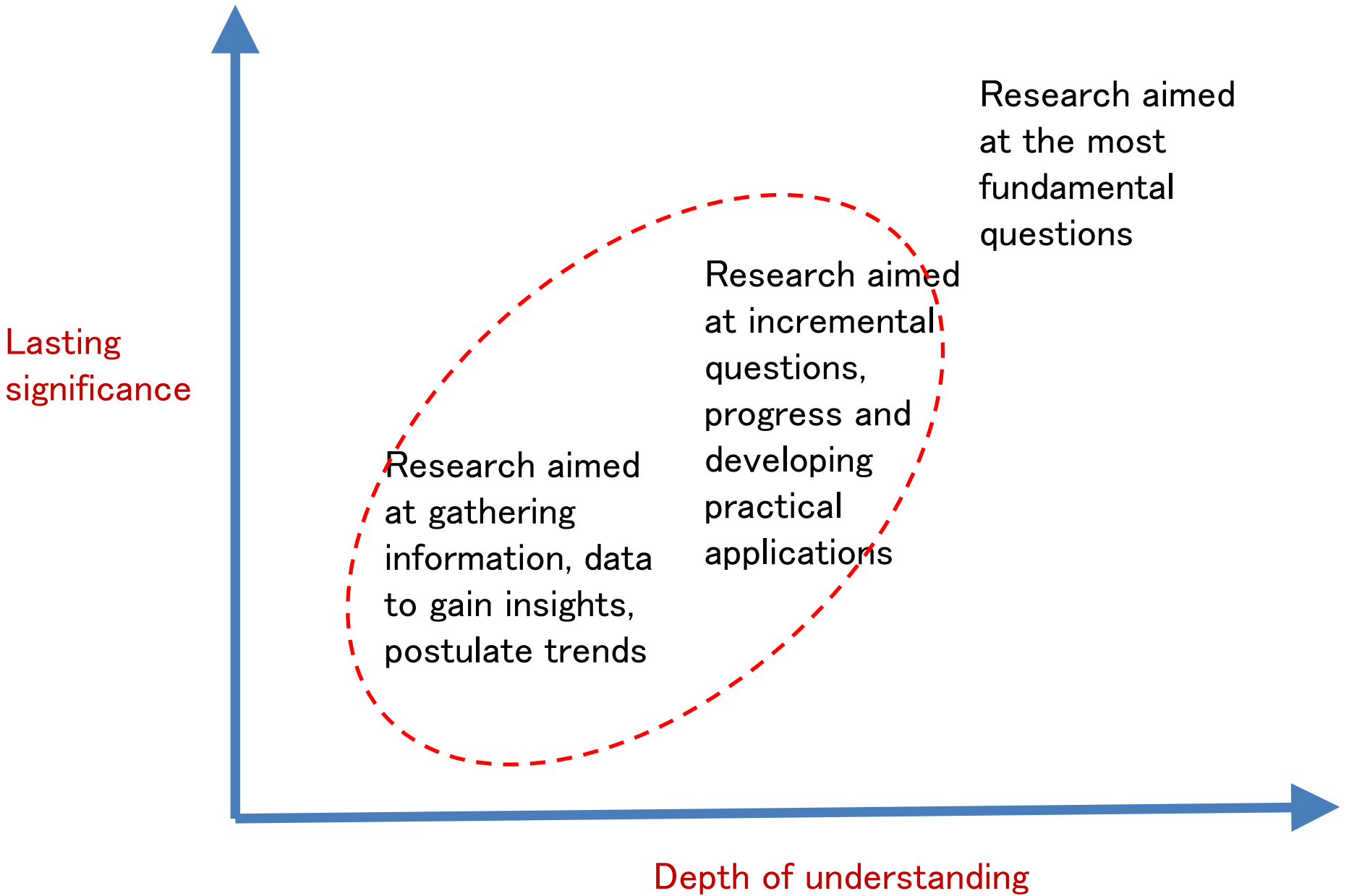
~ \$1.5 trillion in R&D investments
worldwide

Leading nations invest up to ~ 3.5%
GDP on R&D



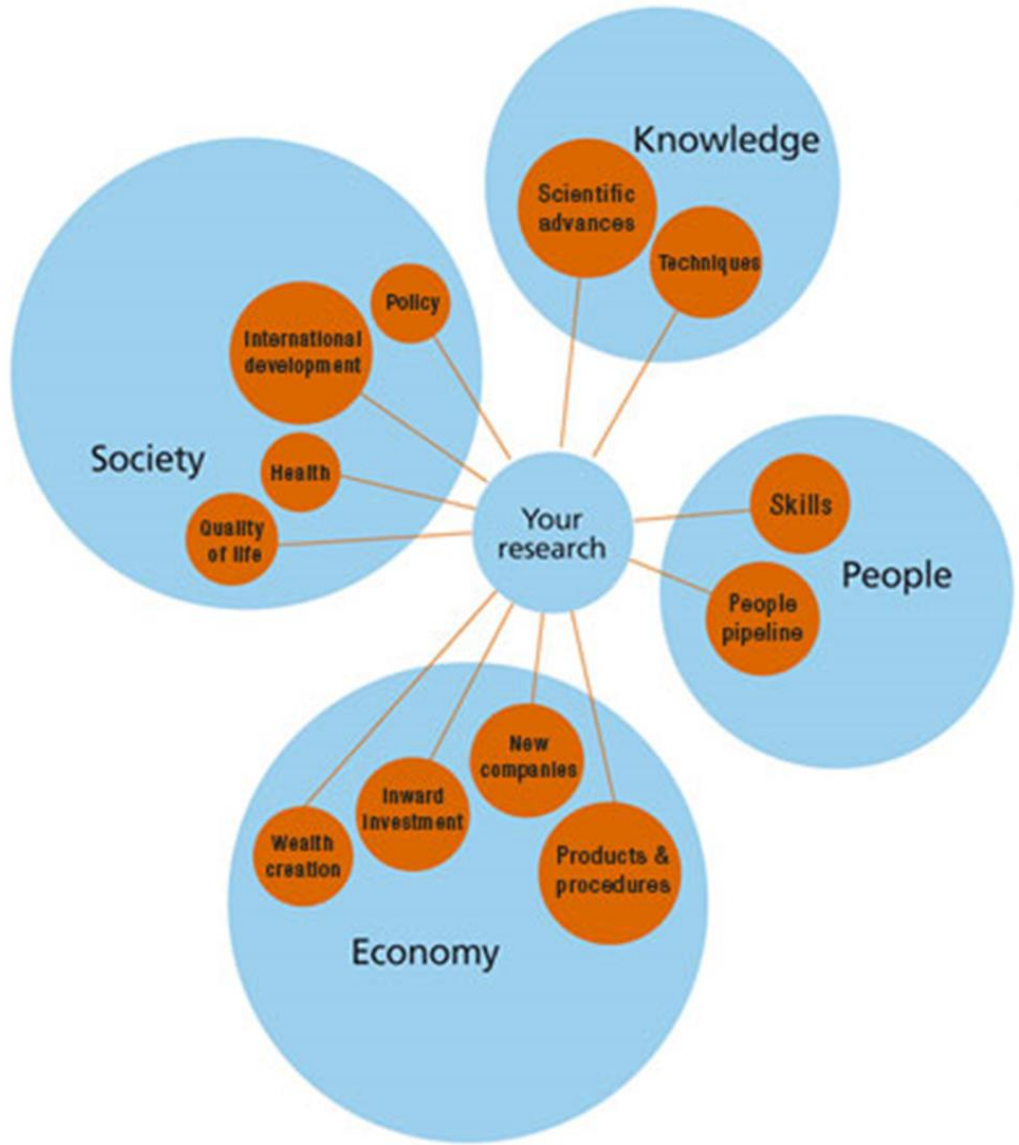
Nature of Research

scientists 'discover', engineers 'invent' and entrepreneurs 'innovate' is an obsolete paradigm



Birth of a new profession: **Research Managers!**

Measuring Academic Research Performance (aka excellence)



Research assessment is a new global business!

- ❑ Thomson Reuters HiCi Researchers
- ❑ WOS InCites; Essential Science Indicators; JCRs; Profiles
- ❑ Microsoft Academic Search
- ❑ Scopus
- ❑ Google Scholar

Parameters used to measure research influence and impact **objectively**:

Papers, citations, citations per paper; H-index; highly cited papers; Quality of journals; leading journals in a discipline and sub-domain



THOMSON REUTERS



THE WORLD'S MOST INFLUENTIAL SCIENTIFIC MINDS 2014

highlycited.com

A hot air balloon soars south of High River and east of the Rocky Mountains during Day 3 of the Canadian Hot Air Balloon Championships. September 27, 2013. REUTERS/Mike Sturk

Highly Cited Researchers in Singapore and Malaysia



| Country | Highly Cited Researchers, HCR (number) http://highlycited.com/ | Population (millions) | HCRs per million population |
|----------------|---|--------------------------|--------------------------------|
| Switzerland | 67 | 8 | 8.375 |
| United States | ~ 1717 | 318.2 | 5.396 |
| United Kingdom | 340 | 63.7 | 5.338 |
| Denmark | 27 | 5.6 | 4.821 |
| Netherlands | 76 | 16.8 | 4.524 |
| Sweden | 28 | 9.7 | 2.887 |
| Singapore | 14 | 5.4 | 2.593 |
| Finland | 14 | 5.4 | 2.593 |
| Germany | 163 | 80.7 | 2.020 |
| Israel | 13 | 8.2 | 1.585 |
| Norway | 7 | 5.1 | 1.373 |
| France | 84 | 65.9 | 1.275 |
| Japan | 98 | 127.1 | 0.771 |
| South Korea | 21 | 50.4 | 0.417 |
| Taiwan | 8 | 23.4 | 0.342 |
| Turkey | 10 | 76.7 | 0.130 |
| China | 160 | 1365 | 0.117 |
| Malaysia | 3 | 30.1 | 0.100 |
| India | 11 | 1245.2 | 0.009 |

Research Organizations

- **Identify** and manage research activities and their impact
- **Benchmark** and compare performance to peers
- **Promote** internal and external partnerships and collaborations
- **Identify** experts both inside and outside the organization
- **Promote** areas of strength and specializations

Funding and Policy Organizations

- **Identify** emerging subject areas, researchers and experts
- **Manage** funding activity from submission to progress reports through outcomes
- **Demonstrate** results and impact of funding policy
- **Identify** new trends and key indicators to enable policy development
- **Increase visibility** of successes

Publishers

- **Uncover** new or emerging areas in which to publish
- **Monitor** trends within a field or geographic region
- **Identify** the best authors and reviewers
- **Maintain** competitive advantage by monitoring the competition



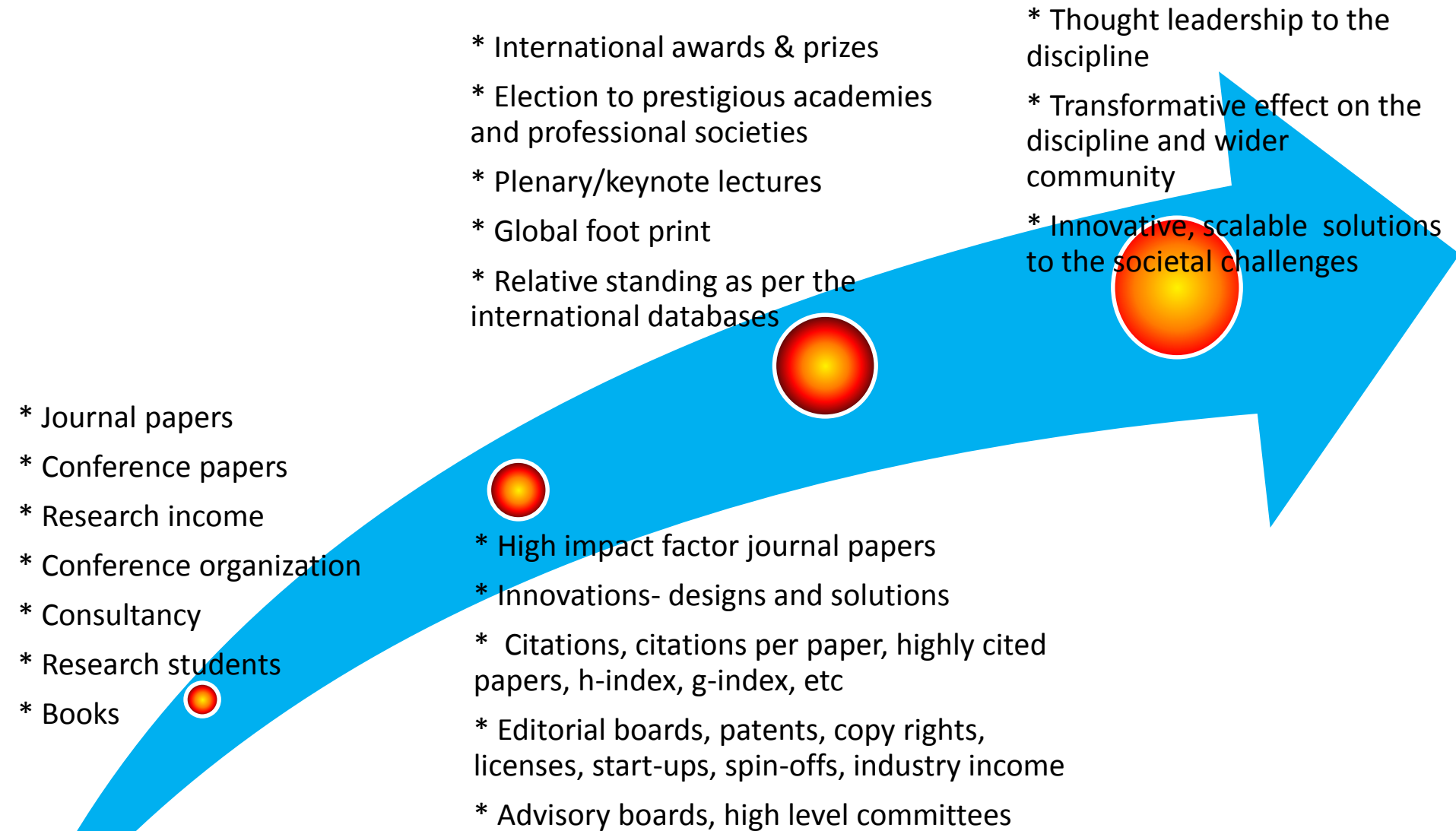
2014 CITATION LAUREATES

PREDICTING NOBEL PRIZES

Using Thomson Reuters
citation data to identify
potential winners

[LEARN MORE](#)

Typical Aspects of Academic Research



- ❑ What is international mobility of researchers?
- ❑ What are the trends?
- ❑ Why is it important?
- ❑ What are the motives of researchers?
- ❑ What are the constraints?
- ❑ What more can be done?

What is international mobility of researchers?

International mobility of researchers include researchers going abroad for employment opportunities, research experience and collaborative research

Is this new?

Is it encouraged?

➤ **Brain Gain**

➤ **Brain Drain**

✓ **Brain Circulation**

International visiting scholars go abroad to engage temporarily in research while maintaining their affiliation and position at the home universities and return after their visiting period ends (short-term brain circulation).



The World Bank Robert S. McNamara Fellowships Program

2015 Call for Active PhD Candidates

The Award: Up to US\$25,000 for a 6–10 month period starting between July and December 2015 to travel to a host institution located in a World Bank member country to conduct development-related PhD research under the supervision of a research advisor. Upon completion of the program McNamara fellows return to their home country for work.

Core Eligibility Criteria:

- Home country is a World Bank member developing country.
- Not a dual citizen of a developed country.
- Currently enrolled in a PhD program in a member country of the World Bank.
- Completed all coursework and exam requirements for your PhD.
- Have a master's degree.
- Be 35 years or younger.
- You meet one of the following conditions:
 - a) You are enrolled in a PhD program in your home country, and not currently employed.
 - b) You are enrolled in a PhD program in your home country or another World Bank member country and are working in an academic or research institution in your home country.

Application Process: Visit the [World Bank Scholarships Program website](http://www.worldbank.org/scholarships) now for the complete list of eligibility criteria and instructions on preparing your application. The online application form will be available on our website between January 7 – February 11, 2015: www.worldbank.org/scholarships.

Some programs for international visiting scholars:

USA: Fulbright program

UK: British Council fellowships

Germany: German Academic Exchange Services

Japan: JSPS fellowships

China: China Scholarship Council fellowships

Brazil: Science without Borders program

Singapore: Study abroad scholarships

Saudi Arabia: King Abdullah scholarship program

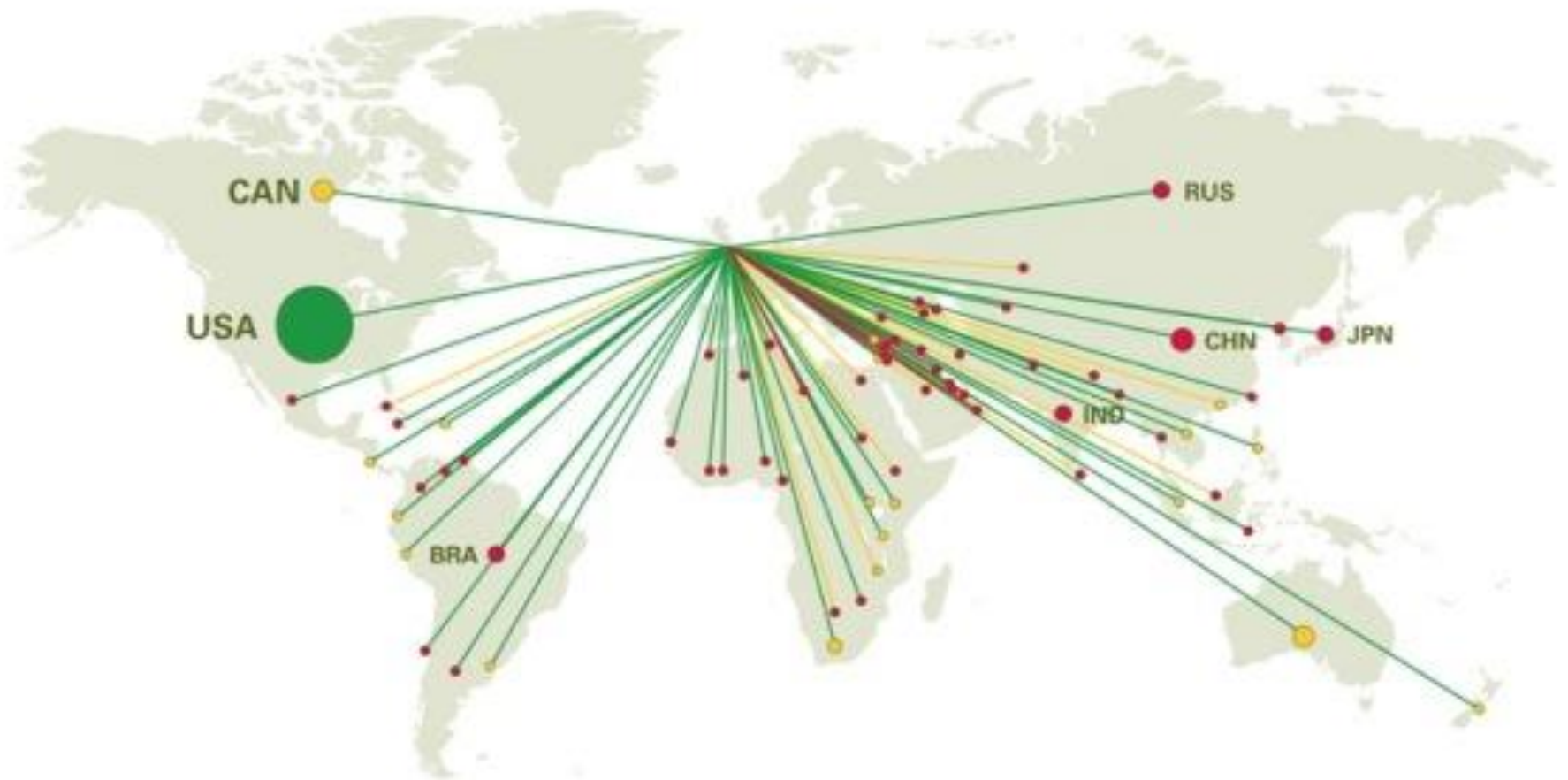
Indonesia: SPIRIT scholarships

Kazakhstan: Bolashak program

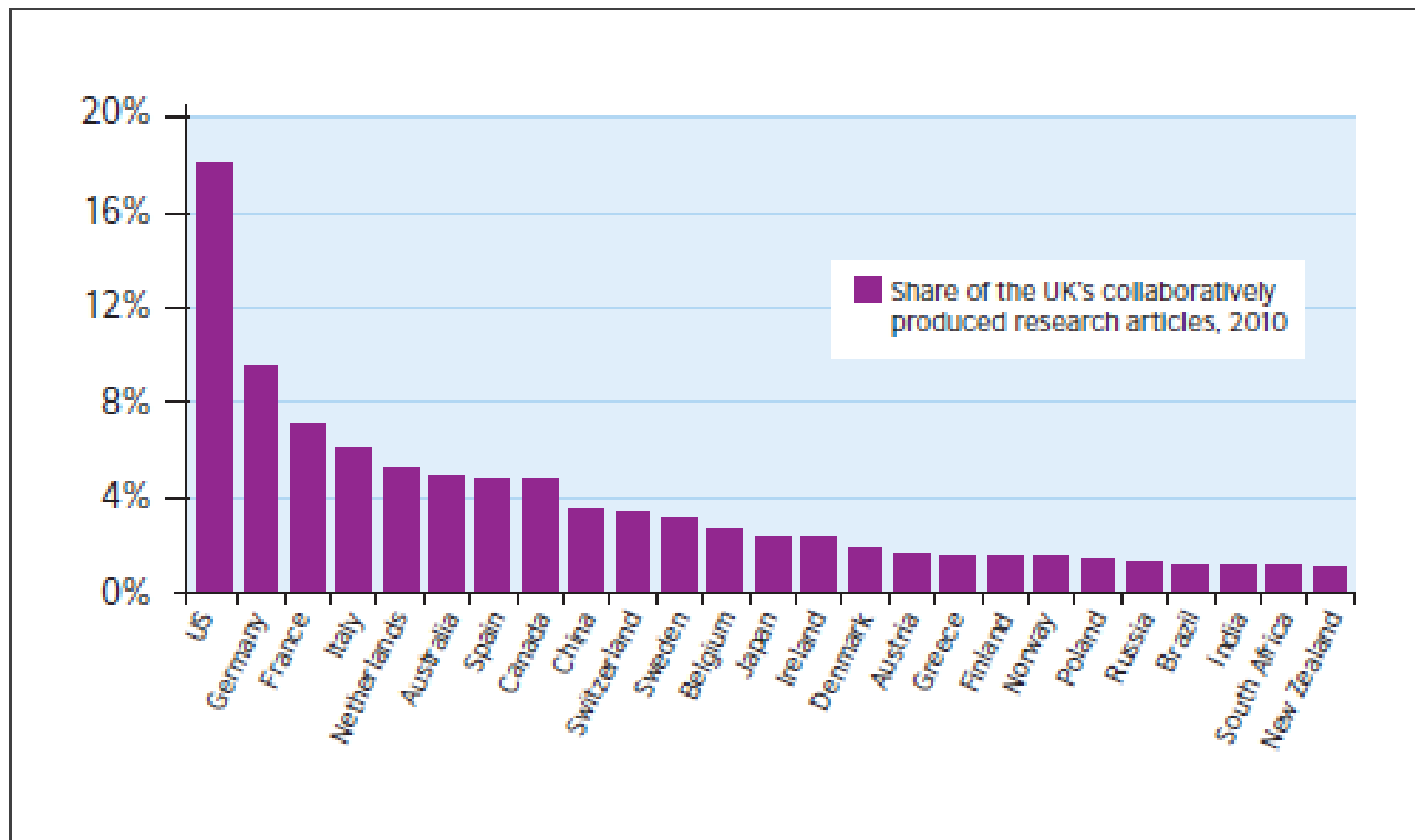
India: CII scholars program

The Institute of International Education reported that in 2011 there were ~ 1400 professors, ~26,500 researchers and ~ 18,000 short-term scholars on J-I visa (exchange visitor visa) in USA.

They originate from China, India, South Korea, Japan, Brazil, Germany, Italy, France, UK and Spain.



UK International collaboration map in the period 2006-2010. Mapped countries include only those with at least 1,000 publications in this period (i.e. 109 countries, representing 99.8% of the UK's internationally co-authored articles). Bubble sizes represent the relative volume of collaboration between the two countries

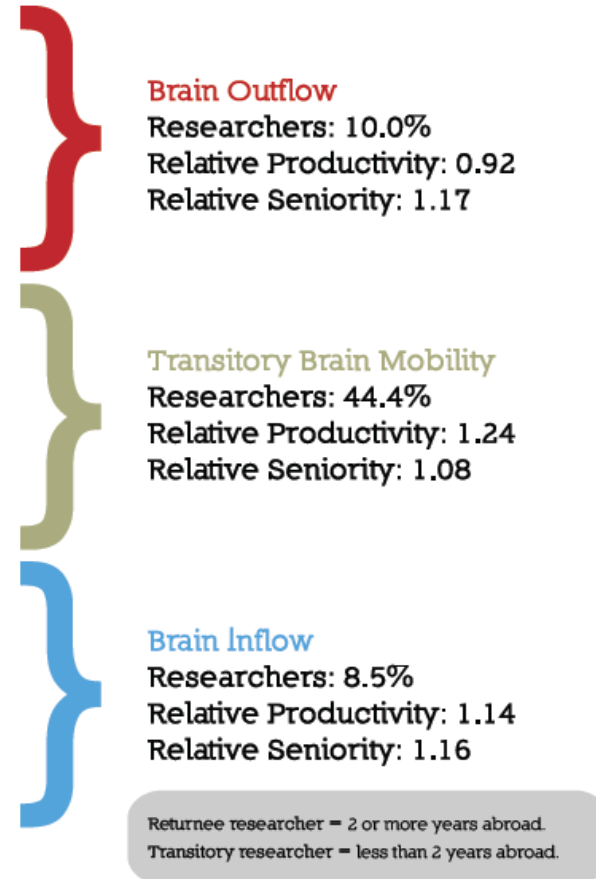


Source: Thomson Reuters Web of Knowledge data, extracted December 2011

Fig 2.8: Top UK collaborative research partners (2010)

Researchers returning to the UK after an extended time abroad are significantly more productive in terms of articles published than those who never left the UK.

Noelle Gracy, Andrew Plume, Elsevier



Academic international research collaboration

- **Largest growth in research output:** Volume growth to be driven by collaborations involving US and Chinese institutions
- **Highest collaboration rates:** Research collaboration rates are higher in many smaller countries, such as Switzerland and Belgium (50–70%); they are lower in China (around 15%). Overall opportunity for collaboration depends on both the volume of research and propensity to collaborate
- **Highest average citation impacts:** Switzerland, Netherlands, Denmark and US – collaborating with these countries in theory should help to maintain and increase research average citation impacts
- **Three core opportunity groups:** Specifically for the UK, future growth in collaborations likely to be with (i) the US and other established high volume research leaders (Germany, France, Italy, Canada, Australia); (ii) high average citation impact leaders (also Switzerland, Netherlands, Denmark) and niche opportunities in smaller, technology-intensive countries such as the Nordic countries, Switzerland and Israel; and (iii) a chance to tap into rapid research output growth in key emerging markets, most notably China but also Malaysia, Iran, Saudi Arabia, India and Qatar

Why is it important?

R&D efforts by researchers that precedes the innovation that drives economic growth in the knowledge economy are hence very important.

National expenditures on R&D are unlikely to increase continuously. Hence facilitating international mobility of researchers is a way to ensure that the research output increases and efficient.

Multinationally-authored articles are more highly cited than those that are not. Smaller or funding constrained research groups to partner with other groups around the world and realize bigger impact. Fostering international collaboration as well as mobility enables to maximize the impact of highly productive research.

Scientific Research Publications

1600-1900s

20th Century

21st Century

*100 pages per year in
1880s*

*5000 pages per year by
end of the century*

*A new paper is
published in every 20
seconds*

*500 pages per year by
1920s*

1 author per paper

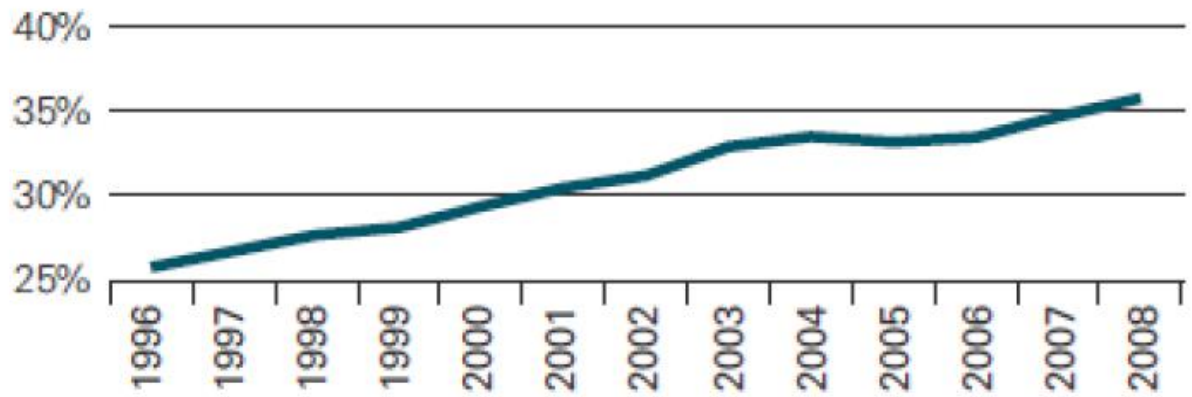
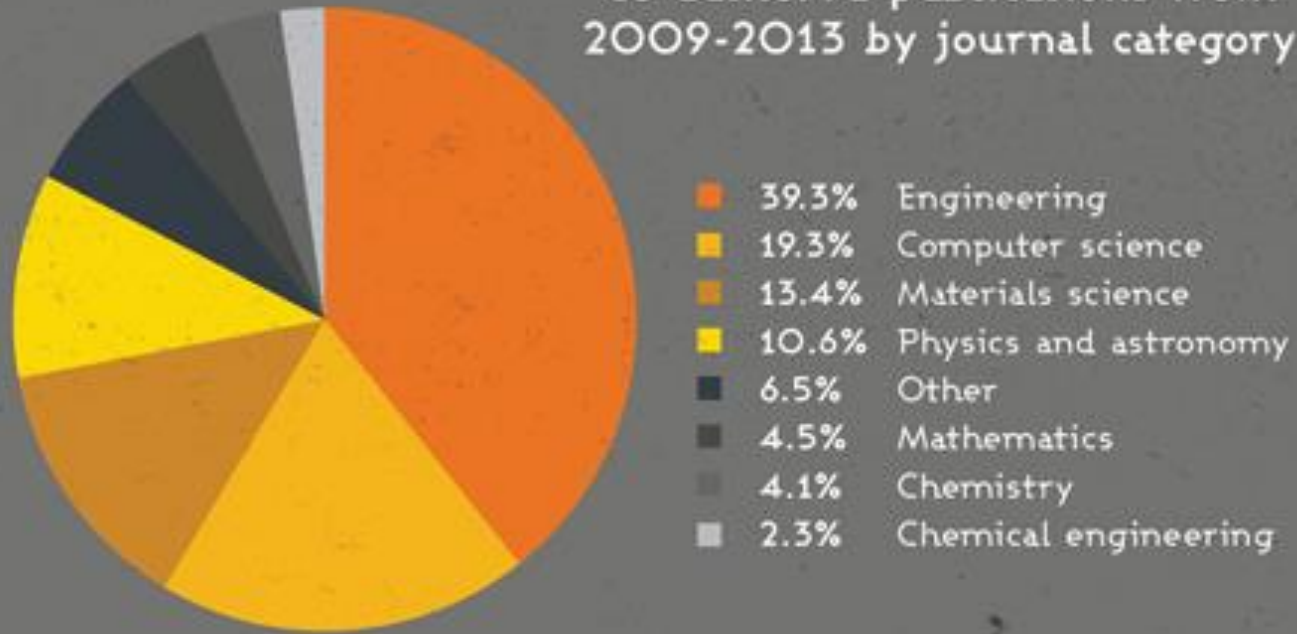
2 to 3 authors per paper

Co-authors from diverse
disciplines and countries

~ several authors per paper

*Some papers with ~ 3000
authors*

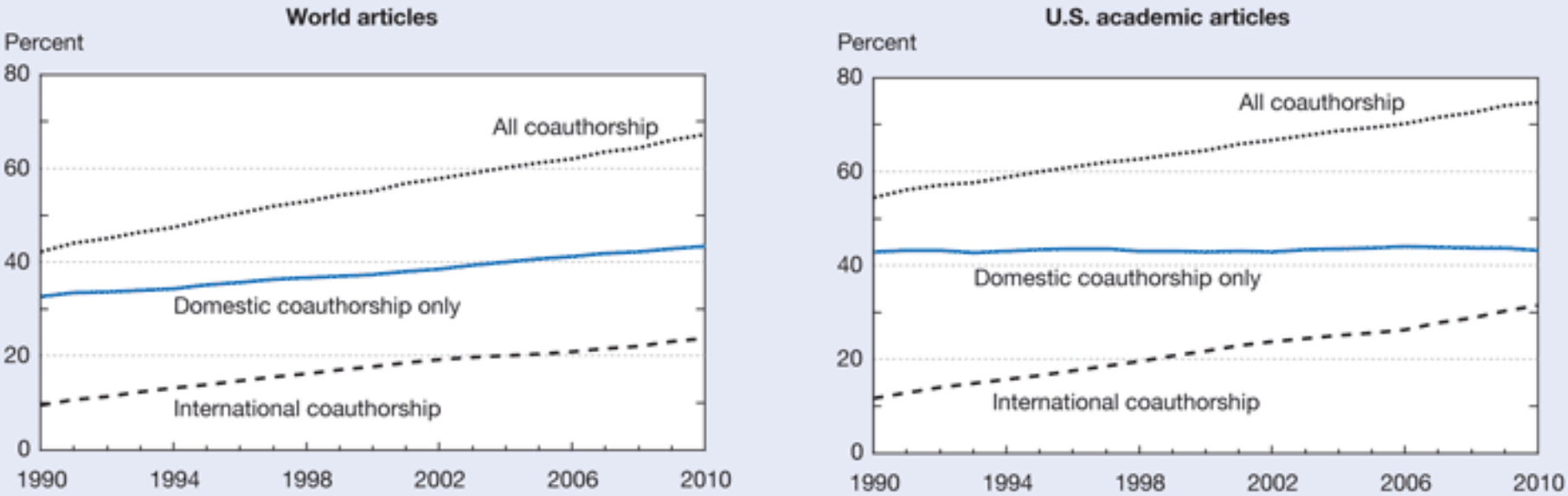
Co-authored publications from 2009-2013 by journal category



Increase in the proportion of world's papers produced with more than one international author

Collaborating beyond borders

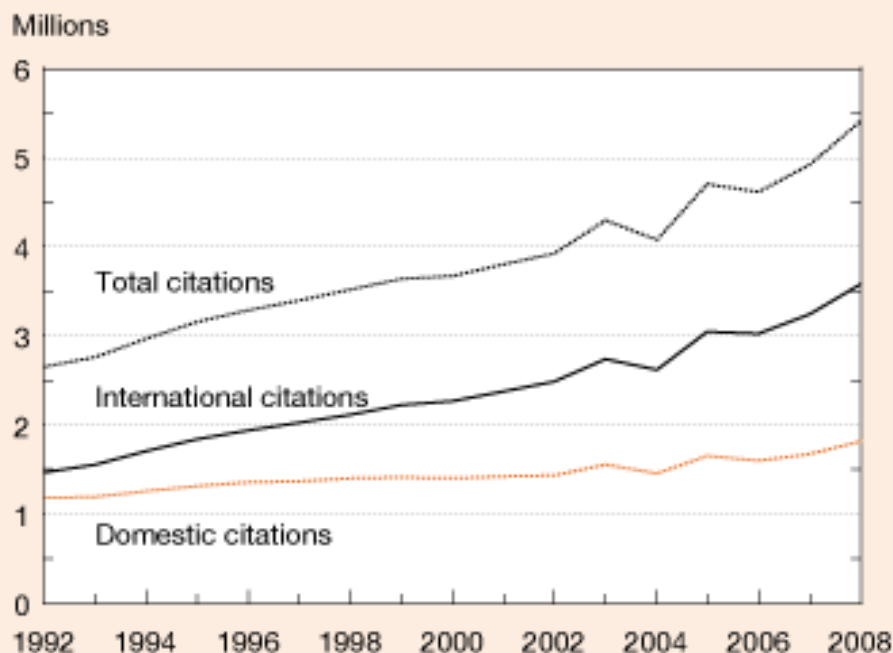
Figure 5-25
World and U.S. academic S&E articles coauthored domestically and internationally: 1990–2010



NOTES: Article counts from set of journals covered by Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). Articles classified by year they entered database, rather than year of publication, and assigned to country/economy on basis of institutional address(es) listed on article. Articles on whole-count basis, i.e., each collaborating institution or country credited one count. Internationally coauthored articles may also have multiple domestic coauthors.

SOURCES: National Science Foundation, National Center for Science and Engineering Statistics, and The Patent Board™, special tabulations (2011) from Thomson Reuters, SCI and SSCI, http://thomsonreuters.com/products_services/science/.

Figure 5-23
**Total, domestic, and international citations:
1992–2008**



NOTES: Citing and cited articles from set of journals covered by Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). Articles classified by year they entered database, rather than year of publication. Citations on fractional-count basis, i.e., for citing and/or cited articles with collaborating institutions from multiple countries, each country receives fractional credit on basis of proportion of its participating institutions. Citation counts based on 3-year period with 2-year lag, e.g., citations for 2008 are references made in articles in 2008 data tape to articles in 2004–06 data tapes.

SOURCES: Thomson Reuters, SCI and SSCI, http://thomson-reuters.com/products_services/science/; The Patent Board™; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

| Country | Total Research articles produced, 2010 (Scopus) | Total collaboratively produced articles, 2010 (Scopus) | Collaboration rate (%) | Citations per document (2010) | Citations per document (1996–2010) |
|-------------|---|--|------------------------|-------------------------------|------------------------------------|
| US | 502,804 | 143,048 | 28.5% | 1.75 | 20.18 |
| UK | 139,683 | 62,061 | 44.4% | 1.81 | 17.42 |
| Germany | 130,031 | 58,150 | 44.7% | 1.76 | 15.79 |
| China | 320,800 | 47,093 | 14.7% | 0.67 | 5.66 |
| France | 94,740 | 44,092 | 46.5% | 1.57 | 15.09 |
| Canada | 77,694 | 34,675 | 44.6% | 1.72 | 17.55 |
| Italy | 73,562 | 30,175 | 41.0% | 1.60 | 14.45 |
| Japan | 113,246 | 26,828 | 23.7% | 1.17 | 11.72 |
| Australia | 59,058 | 25,867 | 43.8% | 1.60 | 16.00 |
| Spain | 64,985 | 25,845 | 39.8% | 1.48 | 13.12 |
| Netherlands | 43,214 | 22,087 | 51.1% | 2.22 | 20.05 |
| Switzerland | 30,866 | 19,208 | 62.2% | 2.38 | 21.77 |
| Sweden | 26,842 | 14,758 | 55.0% | 2.03 | 19.09 |
| South Korea | 55,546 | 14,359 | 25.9% | 1.08 | 9.82 |
| Belgium | 23,716 | 13,573 | 57.2% | 1.95 | 17.10 |
| India | 71,975 | 12,567 | 17.5% | 0.76 | 7.27 |
| Brazil | 45,189 | 11,004 | 24.4% | 0.79 | 9.57 |
| Russia | 36,053 | 10,589 | 29.4% | 0.60 | 5.21 |

Source: Scopus (Elsevier) data, extracted January 2012

Table 2.2: Global share (by volume) of collaboratively produced research articles (2010)

Innovation 0.0

(resources economy)



Innovation 1.0

(manufactured goods economy)



Innovation 2.0 (tech economy)



Innovation 3.0

(information rich, smart economy)



Globally distributed nodes of innovation

Top global institutions within
HE sector for research
produced through international
collaboration

| Rank | Institution | Country | Total research articles, 20 05-2009 (Scopus) | Int. collab. rate (% of total) | Total collab. produced articles, 2005-2009 (Scopus) | Normalised citation impact (1 = global average) | Excellence rate (% within top decile in subject area) | Global inst. rank for total research output (all sectors) |
|------|------------------------------------|---------|--|--------------------------------|---|---|---|---|
| 1 | Harvard University | US | 69,995 | 34.4 | 24,078 | 2.4 | 35.7 | 4 |
| 2 | University of Toronto | CAN | 45,771 | 41.1 | 18,812 | 1.8 | 24.3 | 8 |
| 3 | University of Oxford | UK | 32,354 | 51.6 | 16,695 | 2.0 | 27.5 | 28 |
| 4 | University of Cambridge | UK | 32,900 | 49.8 | 16,384 | 1.9 | 26.7 | 27 |
| 5 | University College London | UK | 33,610 | 46.4 | 15,595 | 1.9 | 28.0 | 26 |
| 6 | Imperial College London | UK | 29,851 | 51.4 | 15,343 | 1.9 | 26.3 | 36 |
| 7 | The University of BC | CAN | 29,569 | 43.7 | 12,922 | 1.7 | 21.7 | 38 |
| 8 | University of Tokyo | JPN | 48,947 | 26.3 | 12,873 | 1.2 | 17.9 | 6 |
| 9 | Johns Hopkins University | US | 41,399 | 29.8 | 12,337 | 2.1 | 30.1 | 10 |
| 10 | University of California, Berkeley | US | 31,943 | 37.4 | 11,947 | 2.1 | 26.6 | 29 |
| 11 | Swiss Federal Institute of Tech. | CH | 20,291 | 58.3 | 11,830 | 1.9 | 24.7 | 79 |
| 12 | Catholic University of Leuven | BEL | 22,498 | 52.2 | 11,744 | 1.7 | 20.9 | 63 |
| 13 | Stanford University | US | 37,885 | 29.5 | 11,176 | 2.3 | 29.1 | 19 |
| 14 | University of California, LA | US | 37,994 | 29.3 | 11,132 | 2.1 | 28.9 | 17 |
| 15 | National University of Singapore | SGP | 25,188 | 44.0 | 11,083 | 1.5 | 17.0 | 51 |
| 16 | U. Pierre et Marie Curie, Paris 6 | FRA | 20,786 | 51.4 | 10,684 | 1.5 | 23.5 | 74 |
| 17 | The University of Manchester | UK | 25,142 | 41.8 | 10,509 | 1.7 | 19.1 | 52 |
| 18 | McGill University | CAN | 23,113 | 45.0 | 10,401 | 1.6 | 23.1 | 58 |
| 19 | University of Michigan, AA | US | 41,059 | 25.3 | 10,388 | 2.0 | 25.6 | 12 |
| 20 | University of Washington | US | 39,428 | 26.2 | 10,330 | 2.1 | 28.6 | 15 |
| 21 | University of California, San D. | US | 31,165 | 32.6 | 10,160 | 2.1 | 29.3 | 31 |
| 22 | Massachusetts Institute of Tech. | US | 29,172 | 34.6 | 10,094 | 2.4 | 26.9 | 40 |
| 23 | University of Sydney | AUS | 24,709 | 40.5 | 10,007 | 1.5 | 18.7 | 53 |
| 24 | University of Sao Paulo | BRA | 40,196 | 24.8 | 9,969 | 0.8 | 9.9 | 13 |
| 25 | Columbia University | US | 33,902 | 29.0 | 9,832 | 2.1 | 27.9 | 25 |
| 26 | University of Copenhagen | DNK | 17,582 | 53.8 | 9,459 | 1.6 | 24.2 | 111 |
| 27 | Utrecht University | NLD | 22,630 | 41.3 | 9,346 | 1.8 | 26.0 | 61 |
| 28 | University of Amsterdam | NLD | 21,134 | 43.0 | 9,088 | 1.8 | 24.9 | 70 |
| 29 | University of Melbourne | AUS | 23,561 | 38.3 | 9,024 | 1.7 | 21.8 | 57 |
| 30 | University of Alberta | CAN | 22,752 | 39.5 | 8,987 | 1.4 | 18.2 | 59 |
| 31 | The University of Edinburgh | UK | 18,515 | 46.8 | 8,665 | 1.8 | 23.4 | 93 |
| 32 | Cornell University | US | 28,921 | 29.9 | 8,647 | 1.8 | 25.5 | 41 |
| 33 | The University of Queensland | AUS | 20,436 | 42.1 | 8,604 | 1.6 | 20.0 | 77 |
| 34 | Karolinska Institute | SWE | 15,693 | 54.3 | 8,521 | 1.8 | 32.1 | 138 |
| 35 | University of California, Davis | US | 28,015 | 30.3 | 8,489 | 1.7 | 23.5 | 44 |
| 36 | Lund University | SWE | 15,713 | 53.8 | 8,454 | 1.6 | 22.9 | 137 |
| 37 | University of Wisconsin | US | 31,789 | 26.3 | 8,361 | 1.8 | 24.2 | 30 |
| 38 | Kyoto University | JPN | 34,813 | 24.0 | 8,355 | 1.2 | 17.9 | 22 |
| 39 | Universität Heidelberg | GER | 20,277 | 40.8 | 8,273 | 1.6 | 24.2 | 80 |
| 40 | Ludwig-Maximilians, Munich | GER | 20,863 | 39.6 | 8,262 | 1.7 | 25.0 | 72 |

Source: Adapted from SCImago Institutions Rankings (SIR), 2011, based on Scopus (Elsevier) data for 2005-09

Notes: Normalised citation impact is relative to the world average, so a rating of 1.3 means the institution is cited 30 per cent more than average. Excellence rate is the percentage of the institution's output included within the top 10 per cent most cited papers in their respective scientific fields. Global institution rankings also include non-HE organisations, for example government, health or private research institutes.

Table 2.3: Top global institutions within HE sector for research produced through international collaboration (2005-09) (Scopus data)



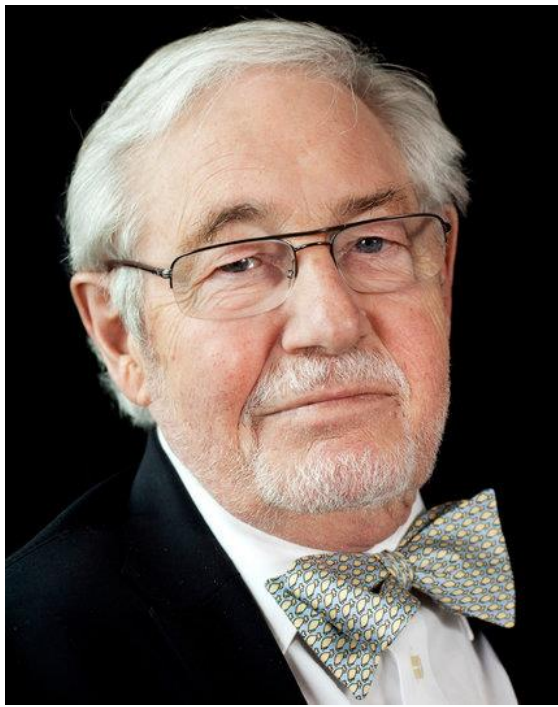
U21 Ranking of National Higher Education Systems 2014

4% weightage to international co-authored papers

| | |
|--|-----|
| International collaboration | 10% |
| Number of Ph.D.s awarded | 5% |
| Number of Ph.D.s awarded per academic staff member | 5% |

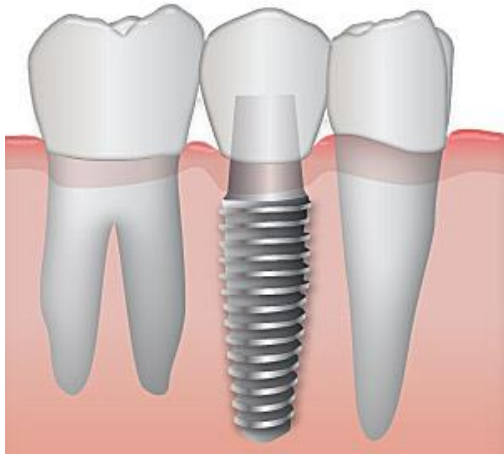
Why researchers need international exposure?

- To broaden professional and personal perspectives
- To develop abilities to absorb new skills and knowledge
- To build trust for collaborations
- To fill the gaps in research
- To embrace new areas
- To explore entrepreneurial opportunities
- To be efficient and effective



Dr. Per-Ingvar Branemark
(1929–2014)

Pioneer of Dental Implant



For years, Dr. Branemark's applications for grants to study implants anchored in bone tissue were rejected. After Dr. Branemark gave a lecture on his work in 1969, Dr. Albrektsson recalled, one of the senior academics of Swedish dentistry rose and referred to an article in Reader's Digest describing Dr. Branemark's research, adding, *'This may prove to be a popular article, but I simply do not trust people who publish themselves in Reader's Digest'*.

Fish in the Pond Imagination of the World



International visiting scholars

International visiting scholars who temporarily visit host countries and then return to their home countries are considered one form of short-term **brain circulation**. Unlike brain drain or brain gain, brain circulation emphasizes the potential benefits for both the sending and receiving countries as a consequence of the continuous and circular moves of scholars.

Brain circulation promotes diversity in university campuses and research & innovation

Universities to put in place facilities, funds and services in the form of

- ✓ orientation program
- ✓ accommodation facilities
- ✓ healthcare facilities
- ✓ visa facilitation
- ✓ spouse support
- ✓ travel support
- ✓ language, cultural, social support
- ✓ Intellectual property policy



Internationalization of Research



- Publicize opportunities for visiting scholars
- Incentives
- Portal for information about the institution, living costs, capabilities, reputation, unique infrastructure, trends, insights, needs and success stories
- Wider sharing of developed knowledge and innovations

Research in Future (2030)

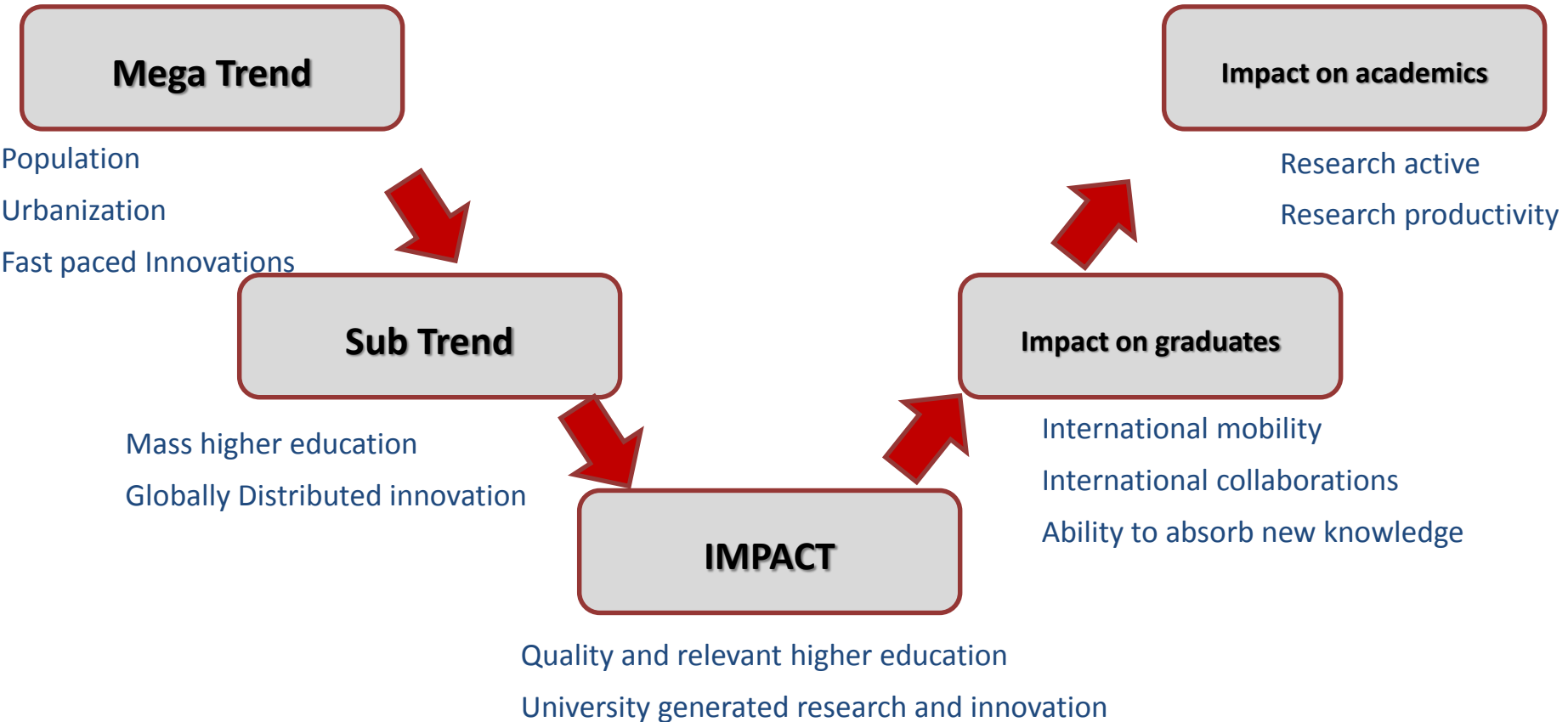
- ❑ More ICT enabled
- ❑ Globally distributed
- ❑ Diversity of actors
- ❑ Collaboration & competition
- ❑ Internationalization

Conclusions

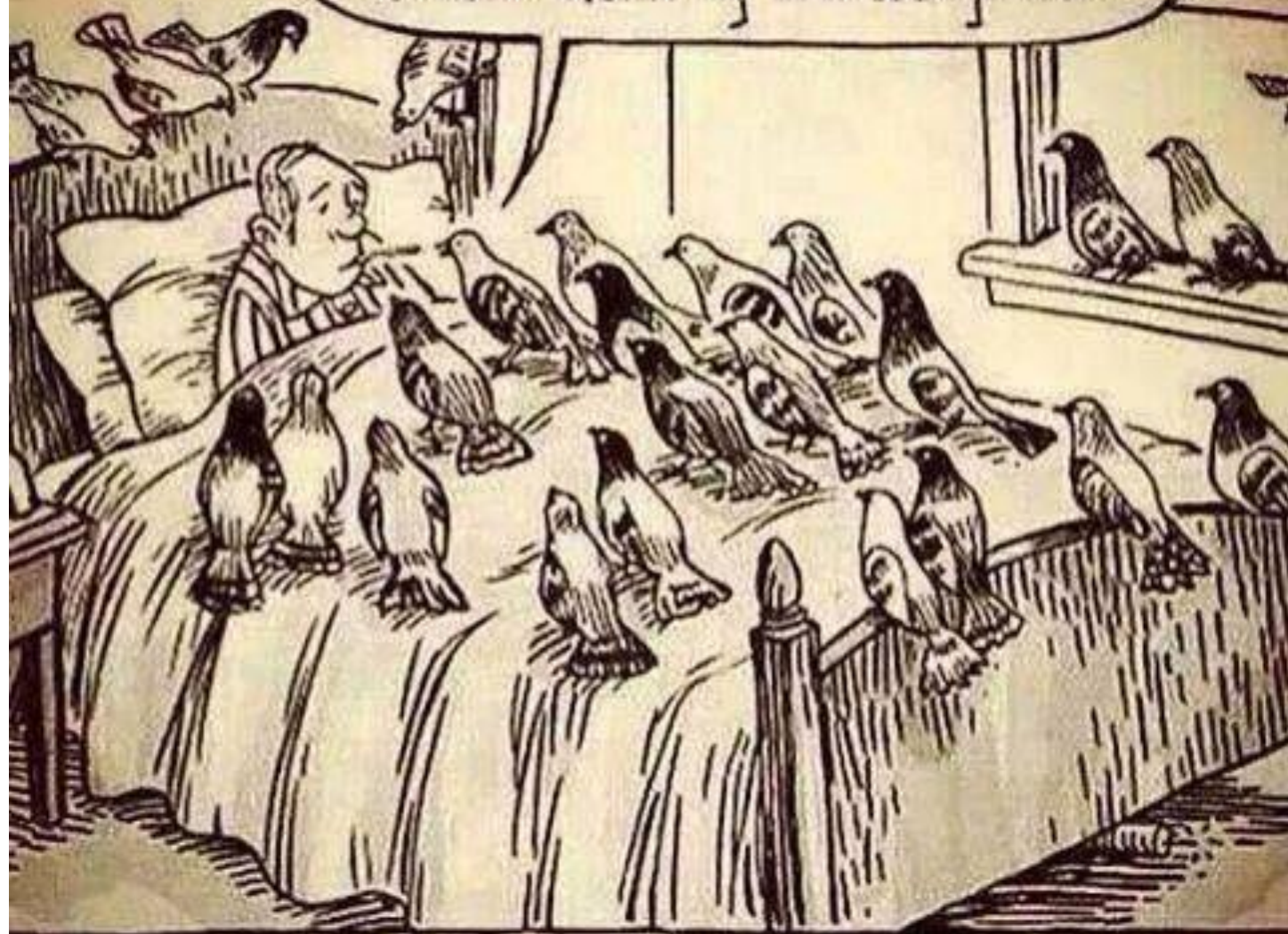
- ❑ International research experience is important in enhancing research productivity and impact. In other words brain circulation is to be facilitated. More over diversity in research spurs innovation.
- ❑ No researcher will have all the necessary research tools and human capital through out his career. Collaboration is the solution in this competitive, fast paced, bean counting world.

Conclusions

- ❖ Brain circulation contributes to the international collaborations, improved research performance, and visibility of universities



We were worried when you didn't show up at the park.

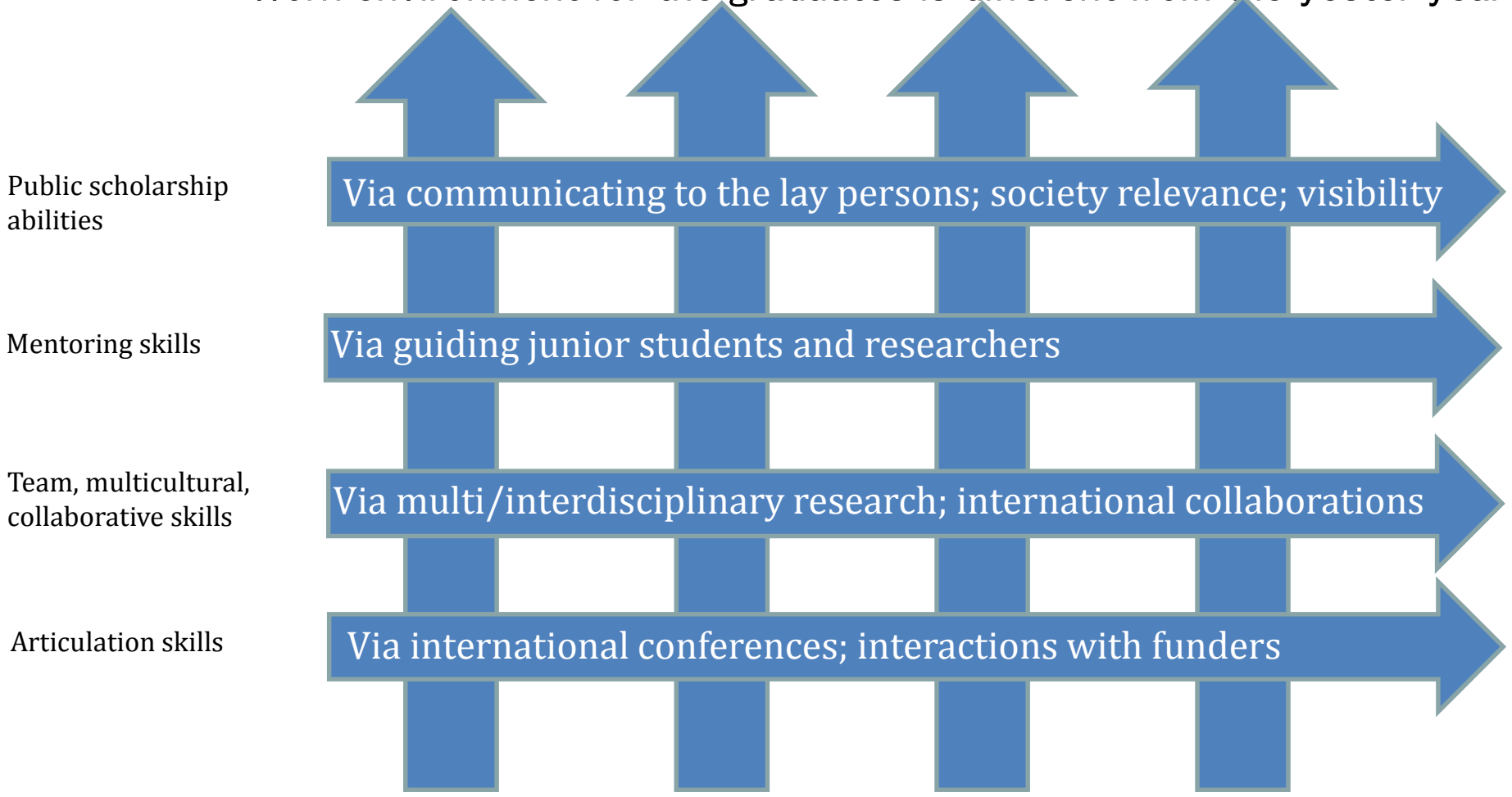


Friends are Forever

Thank you

Developing Graduates and Researchers

Work environment for the graduates is different from the yester years:



Scientific fundamentals & knowledge via course work

Scientific skills via usage of advanced scientific tools & methods

Ethics to avoid plagiarism; fraud; Safety practices

Journal papers & book writing skills; Grant writing skills; IPR protection & transfer skills

Graduate Education now

- Interdisciplinary approach
- International collaboration
- Enterprising mindset

Graduate education of yester years

- Mono-disciplinary
- Depth focused
- Localized

| Country | Total Research articles produced, 2010 (Scopus) | Total collaboratively produced articles, 2010 (Scopus) | Growth in total collaboratively produced articles, 2000–2010 (Scopus) |
|-------------|---|--|---|
| US | 502,804 | 143,048 | 78,000 |
| China | 320,800 | 47,093 | 39,547 |
| UK | 139,683 | 62,061 | 36,340 |
| Germany | 130,031 | 58,150 | 31,940 |
| France | 94,740 | 44,092 | 24,597 |
| Canada | 77,694 | 34,675 | 21,721 |
| Italy | 73,562 | 30,175 | 18,519 |
| Australia | 59,058 | 25,867 | 18,220 |
| Spain | 64,985 | 25,845 | 17,899 |
| Netherlands | 43,214 | 22,087 | 13,607 |
| Japan | 113,246 | 26,828 | 11,603 |
| Switzerland | 30,866 | 19,208 | 11,294 |
| South Korea | 55,546 | 14,359 | 10,710 |
| India | 71,975 | 12,567 | 9,002 |
| Belgium | 23,716 | 13,573 | 8,558 |
| Sweden | 26,842 | 14,758 | 7,877 |
| Brazil | 45,189 | 11,004 | 6,680 |
| Russia | 36,053 | 10,589 | 2,093 |

Source: Scopus (Elsevier) data, extracted January 2012

Table 4.1: Global growth (by volume) of collaboratively produced research articles (2000–10)