

Indicators of Knowledge Transfer, Utilization and Commercialisation

Facing the challenges

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Outline

Complex realities

**Methodological and
measurement challenges**

Additional performance indicators?

Food for thought

“User valued research”

“ ... research activity which is valued by users but which is not recognised for excellence within the academic community in the usual way for its field. ... This body of research resists definition in terms of “basic” or “applied”.

Source: Sweeney, HEFCE (2008)

Which ‘users’?

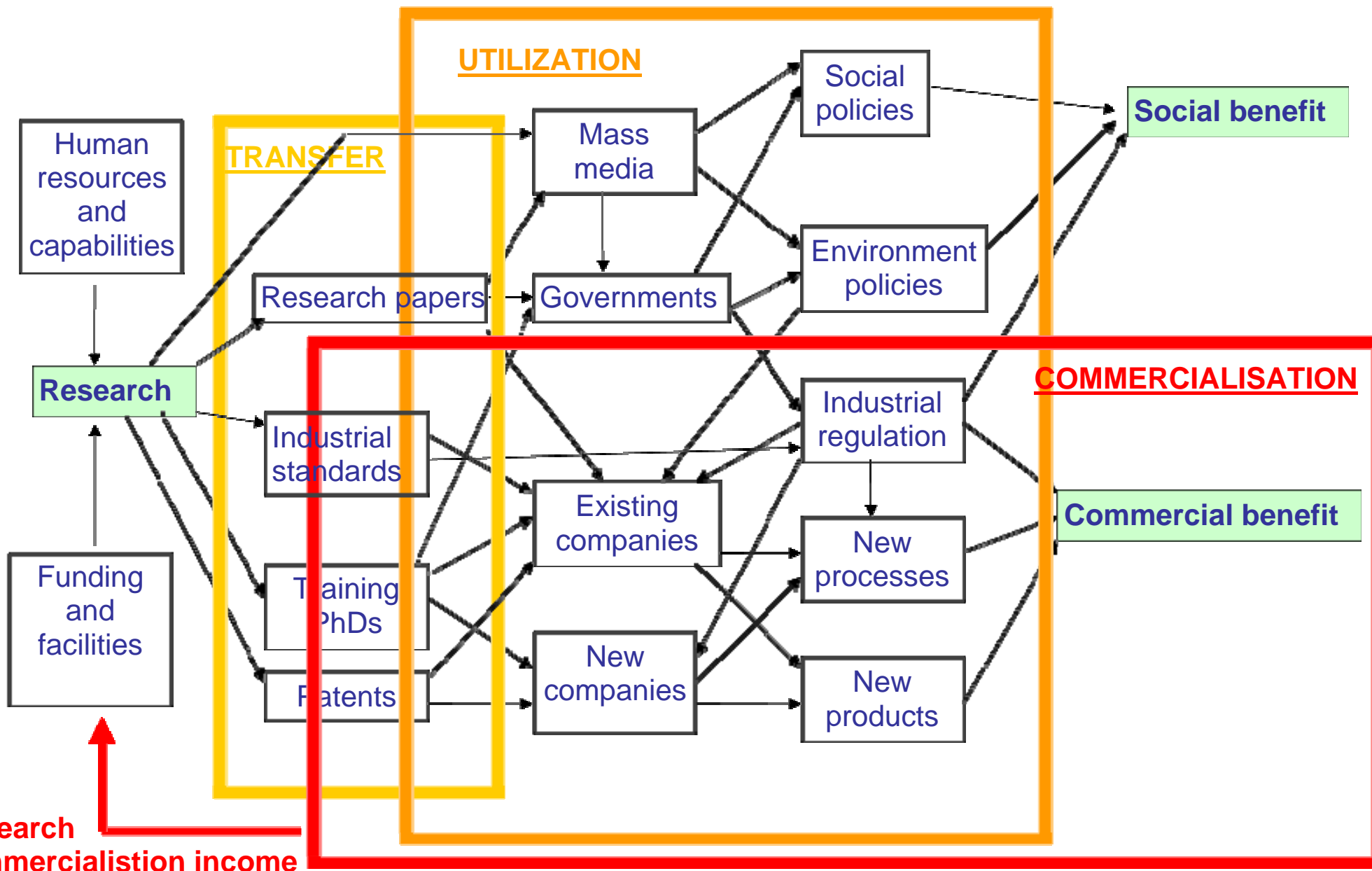
What kind of usage? (and when?)

How to define ‘value’? (for society? for money?)

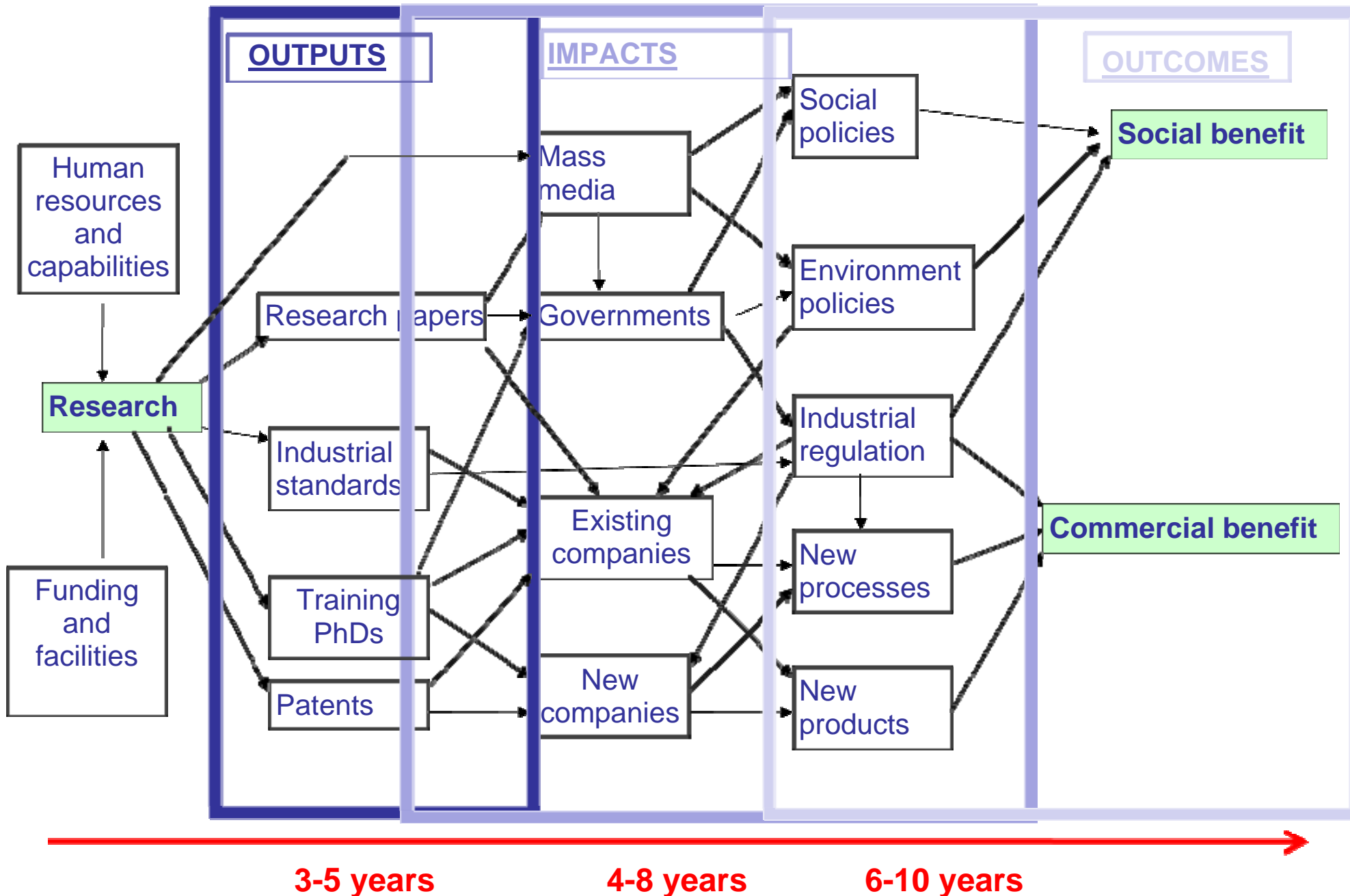
Impacts of research

	Direct impacts		Indirect impacts	
	<i>Short term</i>	<i>Long term</i>	<i>Short term</i>	<i>Long term</i>
Science	Research findings	Knowledge and capabilities, competitive science base	Improved teaching, experience, and skills	Spill-overs to business sector and society
Economy	Improved methods and technologies	Improved technical skills, innovations	Increased know-how and productivity	Improved competitiveness and improved welfare
Society	improved understanding	Improved problem-solving capabilities	Increased problem awareness	increased general satisfaction, cultural enlightenment and increased well-being

Downstream effects of public sector research



Measurement categories of downstream effects



Assessment tools, approaches and information sources

1. Bibliometric analysis
 2. Expert review (of outputs)
 3. Other available statistical indicators
 4. Information submitted by institutes
- All inputs need to be collected and interpreted with advice from experts
 - Performance measurements and statistical indicators might not be feasible, nor the primary approach for assessment



SMART indicators

Criteria for developing performance indicators

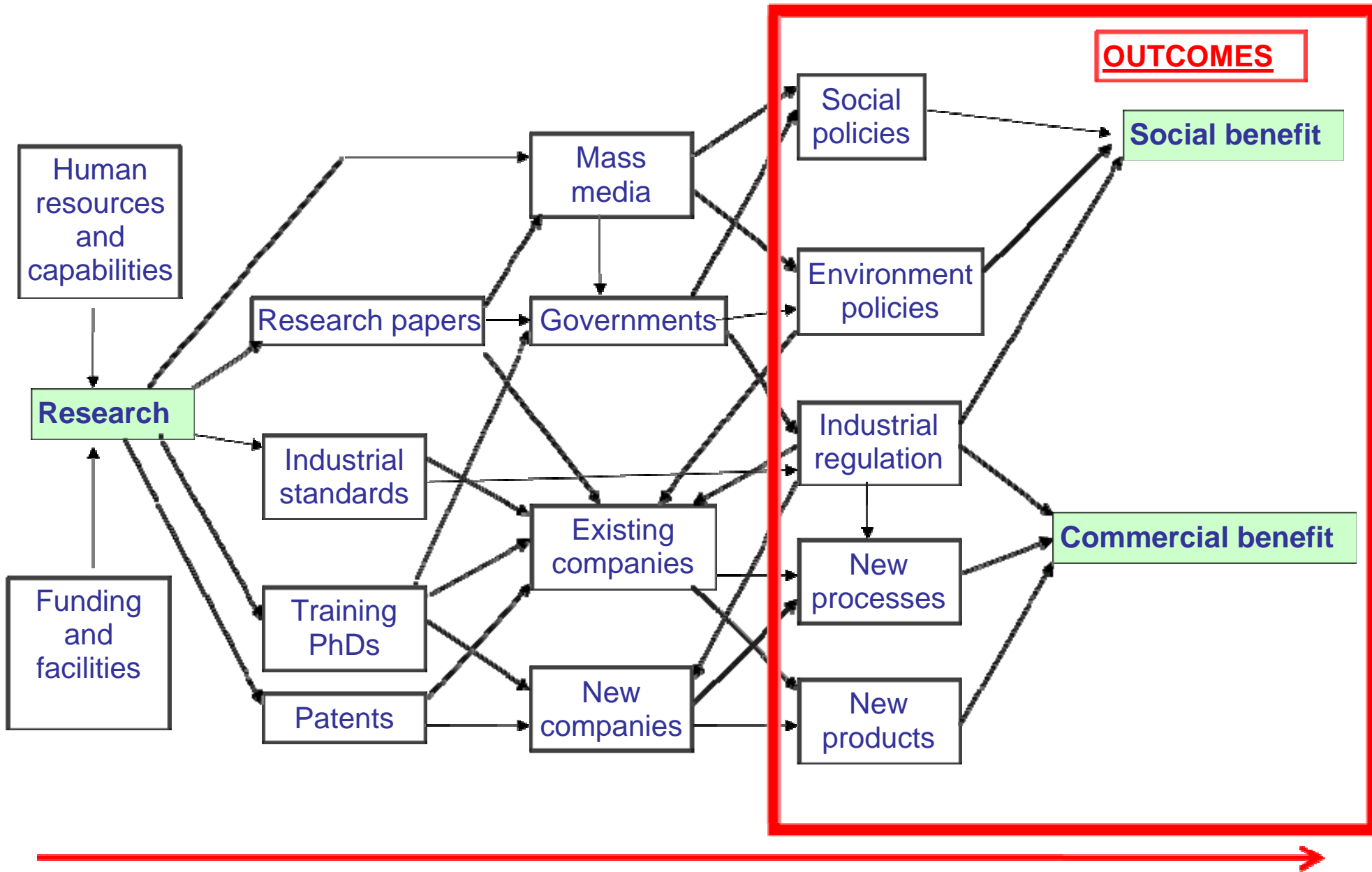
- **S**pecific
- **M**easurable
- **A**ceptable
- **R**elevant
- **T**ime dependent

Criteria for implementation

- Objective information
- Transparent methods
- Comparable across units
- Workable solutions
- Cost-effective for users and producers



Outcome indicators



6-10 years

Output indicators?

Prizes and awards

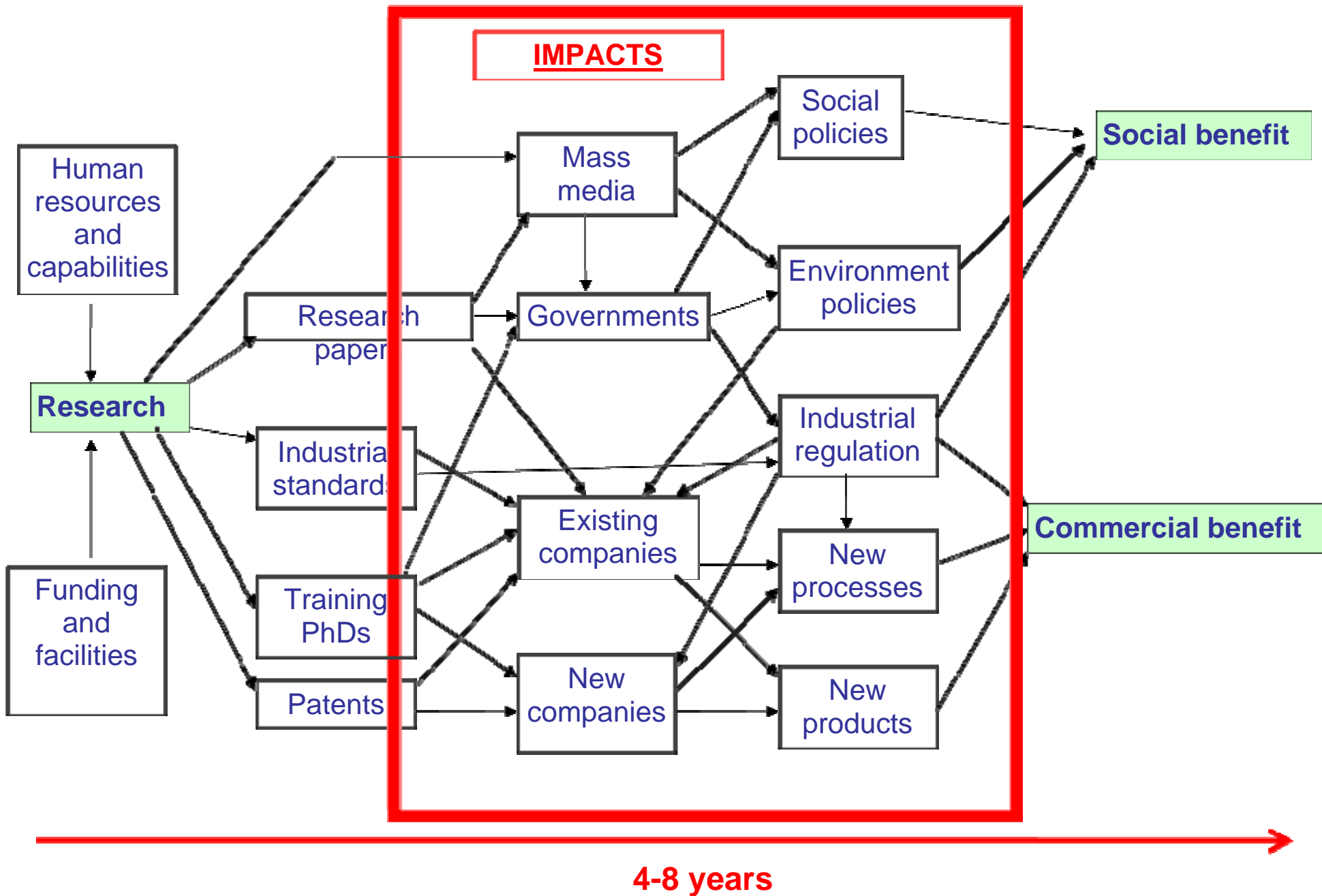
- Prestigious (innovation) prizes awarded by business sector associations (national/international)
- Prestigious prizes awarded by public sector organisations (national/international)

Acknowledged substantial contributions to policy debates, governments decision-making, laws and regulations

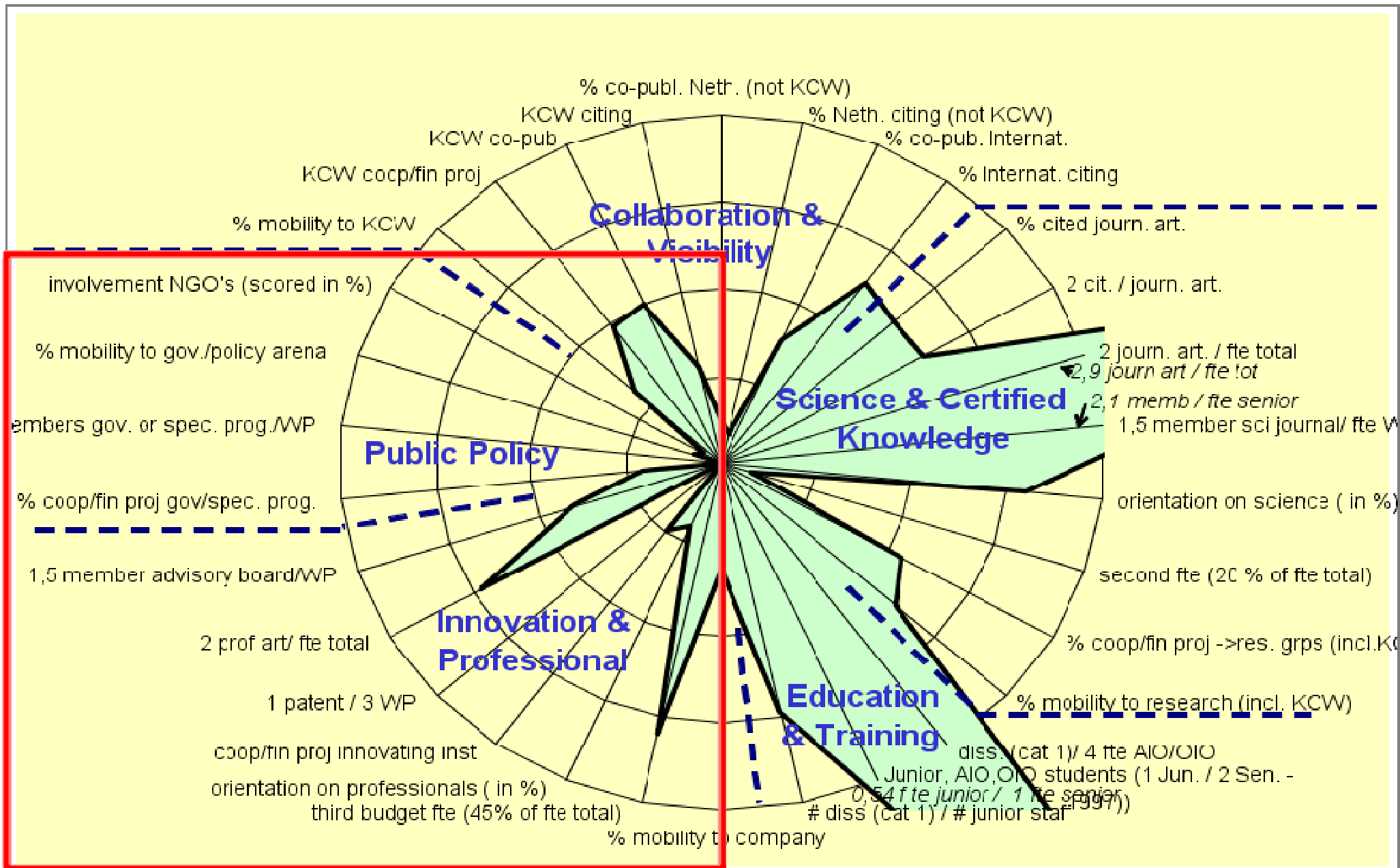
Entrepreneurial indicators?

Sales, revenues, profits, jobs generated by (spin-off) companies
research-based innovations sold to other companies

Impact indicators



REPP of research unit *Crop and Grassland Science* at *Wageningen Agricultural University - KCW* (1998)



REPP Indicators

Education and training

- PhD training
- Junior staff

Science and certified knowledge

- Publication output
- Scientific cooperation
- Research council funding

Internal cooperation and visibility

- In-house cooperation and funding
- In-house citations

Public Policy

- Government funded research
- Mobility of staff to government

Innovation and professional activities

- Member of advisory boards
- Professional publications
- Patents
- Contract income
- Mobility to industry

Other impact indicators

Citations in non-academic publications to research publications

Policy reports

Clinical guidelines

Patents

Technical manuals

Appearances and citations in the media and popular press

Radio

TV

Newspapers

Magazines

Blogs

Authorship of authoritative reviews

Scientific journals

Other publication outlets

Indicator:

Patent references to the research literature

Definition

- quantity of references within patents to research articles that were (co)produced by an organisation

Relevance

- process indicator reflecting the ability to conduct scientific research that is relevant in the context of patented knowledge and technologies

Data retrieval

- data can only be extracted from appropriate patent databases (EPO/PATSTAT, USPTO)

Challenges

- ensure that all references to research articles are identified (*Web of Science*, *Scopus* or other databases)

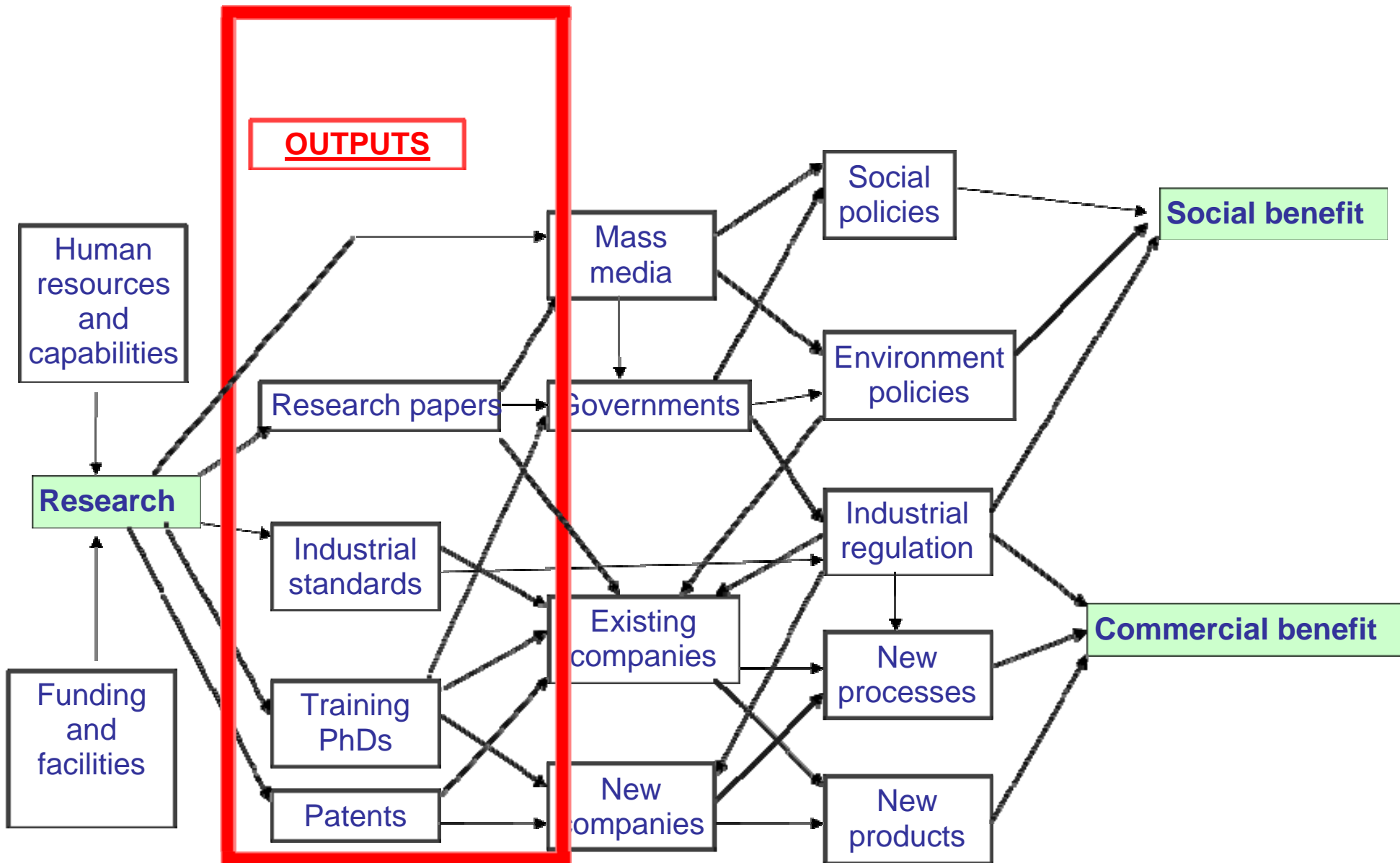
Patent citations to WoS-indexed research publications by Australian and New Zealand universities

Top 20 most highly cited universities

University	Citations	University	Citations
Univ Melbourne	458	Univ Canterbury	75
Univ Sydney	392	Macquarie Univ	73
Univ Queensland	306	Griffith Univ	72
Univ New S Wales	289	La Trobe Univ	72
Monash Univ	279	Royal Melbourne Inst Techn	60
Australian Nat Univ	212	Flinders Univ S Aust	59
Univ Adelaide	176	Massey Univ	51
Univ Auckland	172	Univ Technol Sydney	48
Univ W Australia	144	Queensland Univ Techn	40
Univ Otago	90	Univ South Australia	37

Sources; CWTS/PATSTAT database (1996-2005); CWTS/TR Web of Science database (1980-2008)

Output indicators



3-5 years

Additional output indicators?

PhDs moving outside the Higher Education system

Government

Industry

Inventors

Patents assigned to non-HE institutes

University-Industry research co-publications

Academic journals and conference proceedings

Other publication outlets

Indicator:

Mobility and employment of PhDs

Definition

- institutional sector where PhDs find employment

Relevance

- outcome indicator of knowledge transfer and utilization within society

Data retrieval

- university alumni databases and/or national registries

Challenges

- creating and maintaining these databases

Indicator:

author/inventor R&D outputs

Definition

- researchers listed as (co-)authors on research publications and as (co-)inventors of patents

Relevance

- process indicator reflecting flows of embodied knowledge and skills; science-technology linkages
- output indicator of science-based technical inventions and innovations

Data retrieval

- data extracted from publication databases (WoS, Scopus) and patent databases

Challenges

- matching author names and inventor names

Hidden university inventors



USPTO and EPO patents filed by an assignee based in the Netherlands (2002-2003)

	Biotech	ICT
Selected patents	701	2 380
Inventors residing in the Netherlands	1 100	2 435
Inventors employed by universities in the Netherlands	293 (27%)	45 (2%)

Indicator:

Public-private research co-publications

Definition

- quantity of research publications that are co-authored by researchers employed by a public sector organisation and those employed by a private sector organisation

Relevance

- process and output indicator that reflects the ability to conduct successful scientific research in cooperation with the private sector

Data retrieval

- data can only be extracted from databases with full information on author affiliate addresses (e.g. *Web of Science* or *Scopus*)

Challenges

- ensure that all these co-publications are (unambiguously) identified within the database(s)

University-industry cooperation and co-publications

Publications listing a university and a private sector organization within the author affiliate address information are classified as *university-industry co-publications* (UICs):

- “Domestic UICs”: private sector partner based in the same country as the university
- “Foreign UICs”: private sector partner based abroad

Information source: Thomson Reuters *Web of Science* database

UICs reflect effective and fruitful research that not only produced valuable results worth disseminating to a wider international public of peers, but also inspired collaborating partners to invest time and money to draft a high-quality research article for publication in a peer-reviewed journal

Top 10 universities by UIC output

World Top 350 Universities (2002-2006)

			UIC output	UIC intensity	Domestic industry partners
1	Univ. Tokyo	Japan	2 353	8%	91%
2	Harvard Univ.	USA	2 127	5%	87%
3	Osaka Univ.	Japan	1 631	9%	93%
4	Kyoto Univ.	Japan	1 473	7%	89%
5	Tohoku Univ.	Japan	1 401	8%	93%
6	Univ. Calif. - Los Angeles	USA	1 325	6%	91%
7	Johns Hopkins Univ.	USA	1 175	5%	87%
8	Stanford Univ.	USA	1 161	6%	86%
9	Univ. Washington Seattle	USA	1 045	5%	87%
10	Tokyo Inst. Technol.	Japan	1 006	10%	96%

Source: CWTS Scoreboard of University-Industry Research Cooperation
www.socialsciences.leidenuniv.nl/cwts/copy_of_scoreboard.jsp

Australian and New Zealand universities

Included in World Top 350 Universities

		UIC intensity	Domestic industry partners
Univ Auckland	New Zealand	2.5%	31%
Univ Melbourne	Australia	2.2%	10%
Univ New S Wales	Australia	2.2%	25%
Monash Univ	Australia	2.1%	12%
Univ. Queensland	Australia	1.9%	18%
Univ Otago	New Zealand	1.9%	46%
Univ Adelaide	Australia	1.8%	32%
Australian Nat Univ	Australia	1.1%	9%

Source: CWTS Scoreboard of University-Industry Research Cooperation
www.socialsciences.leidenuniv.nl/cwts/copy_of_scoreboard.jsp

Food for thought

*Conclusions
and recommendations*

Methodological challenges

- What are the main gaps in our understanding?
- Which statistical information and performance indicators may add relevant new information?
- Which sources (field-dependent) criteria are suitable for assessment?
- How to reconcile data from various sources and indicators?
- Are the data “fair” (reliable, valid and verifiable)?
- How to interpret statistical results? (avoiding ‘mechanical’ approaches)

- What is the added value of bibliometric indicators? (as a replacement or supplement to peer review panel data)
- What are the major trade-offs? (added value vs. cost effectiveness)

How can we judge the value of indicators?

Relevant and appropriate

Are these the tools that scientists and scholars would use?

Are 'metrics' correlated with other performance estimates?

Do metrics really distinguish 'performance' as we see it?

Cost effective

Data accessibility, coverage, validation & verification

Transparent, equitable and stable

Is it clear what the metrics do?

Are all institutes, staff and disciplines treated equitably?

How do people respond, and can they manipulate metrics?

Goodhart's Law

"... any observed statistical regularity will tend to collapse once pressure is placed upon it for control purposes"

Charles Goodhart, "Monetary Relationships: A View from Threadneedle Street".
Papers in Monetary Economics (Reserve Bank of Australia), 1975

Once an indicator, or other surrogate measure, is made a target for the purpose of conducting social or economic policy, then it will gradually lose the information content that would qualify it to play such a role

Entrepreneurial performance indicators?

- Indicators should act as incentives (to institutions and individuals) in order to focus research cultures towards the user value of applications
- Suite of output and impact indicators (PhD careers, UICs, co-inventors, patent citations, IP, research commercialisation income)
- Analysts and users should recognize complexities (feedback loops) and timescales required from lab bench to wealth generation

- A modified indicator system should encourage the formation of sustainable entrepreneurial infrastructures within universities, and raise visibility of entrepreneurial individuals (career mobility) and be used in departmental ranking (attracting students, staff and income)
- Establish cross-disciplinary panels (or several discipline-based panels) with experts capable of assessing evidence portfolios dealing with specifically with (longer term) applications of research

Performance indicators should be discipline-specific

Few will be applicable across all or most disciplines (or discipline clusters)

Replace/supplement inappropriate indicators by institute-specific ones ?

No generally acceptable indicators (yet) ?

Apply peer review ! (on samples)

Challenge for the (near) future

- Tailored ‘many sizes fits all’ assessment frameworks
 - More information sources, better indicators and feedback-driven mechanisms
- ... *where peer reviews, external indicator-based assessments, and (indicator-based) self-assessments reinforce each other!*

Thank you for your attention

More information?

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www.socialsciences.leidenuniv.nl/cwts/