FCC Week 2019

Economics of Science

Designing a Research Infrastructure with impact in mind

Creating impact – the next step

Silvia Vignetti

25 June 2019, Brussels

CSIL Centre for Industrial Studies
Corso Monforte 15, 20122 Milano, Italy
tel.+39 02 796630 fax +39 02 780703
csil@csilmilano.com www.csilmilano.com

Outline

- Motivation
- Impact assessment plan
- Data collection

RATIONALE

Evidence

- Increasing demand of socio-economic impact assessment since Preparatory Phase (ex. H2020, ESFRI, etc.)
- Impact assessment performed episodically
- Carried out mainly upon requests of external stakeholders
- Lack of internal resources and expertise
- Need for deep understanding and collaboration of RI managers

=> Impact assessment must be planned in advance and used as a strategic management tool

Definitions

- *Impact assessment (IA) is a **structured a process for considering the implications**, for people and their environment, of proposed actions while there is still an opportunity to modify (or even, if appropriate, abandon) the proposals. It is applied at all levels of decision-making, from policies to specific projects.* *(Source: IAIA.org)*

- IA linked but not identical to:
  - **Monitoring**: continuous process generating data to track the progress of an action => critical to evaluations
  - **Audit**: focus on financial reporting and compliance with rules

=> It requires a well identified plan

Setting up an IA plan

- Who does what
- When (ex-ante, in itinere, ex-post, routinely every x years, etc)
- What (types of impacts)
- How (methods and tools)
- Data collection plan
- Use: feedback on strategy and management

DATA COLLECTION

Different dimensions

Despite different methodological approaches there is some consensus about the channels of impacts of RI:

- Scientific impact
- Education impact
- Technological spillover and innovation
- Cultural and outreach
- Science as a public good

see for example Martin, 1996 and Martin and Tang, 2007, Florio et al., 2016

Scientific impact: value of knowledge and its dissemination

- Indicators
  - ✓ *N. of scientific publications (in impacted/peer-reviewed journals, periodicals, technical reports, …).*
    - – of authors/scientists from the RI or
    - – scientists using the RI
  - ✓ *N. of citations (track the wave of knowledge dissemination)*
  - ✓ *N. of attendees to conferences, workshops, seminars*
  - ✓ *Origin and duration of stay*
  - ✓ *Travel costs*
  - ✓ *Time needed to produce/use scientific outputs*
  - ✓ *Yearly salary of scientists*

- Tools
  - ✓ *Mandatory citation system*
  - ✓ *tracking system on existing databases (web of science, Scopus, PubMed, arXiv, INSPIRE, etc..) based on word search*

Example

Cumulative number of papers to 2012 from LHC and LEP experiments, compared

Experiment	Experiment Papers (Including Preprints)	Published Experiment Papers	Experiment Papers Cited in the Literature	Literature Cited by Experiment Papers
LEP				
ALEPH	636	589	383	3,233
DELPHI	736	670	417	3,644
L3	605	549	381	3,563
OPAL	694	634	475	4,037
CDF	3,077	2,386	1,641	6,616
D0	2,383	1,769	1,176	4,744
LHC				
ALICE	1,579	945	382	2,963
ATLAS	2,529	1,921	1,195	4,862
CMS	2,580	1,603	1,030	4,640
LHCb	735	585	248	1,608

Source: Adapted from Carrazza, Ferrara, and Salini (2016). Data extracted in September 2013 from the INSPIRE website (http://inspirehep.net).

Example

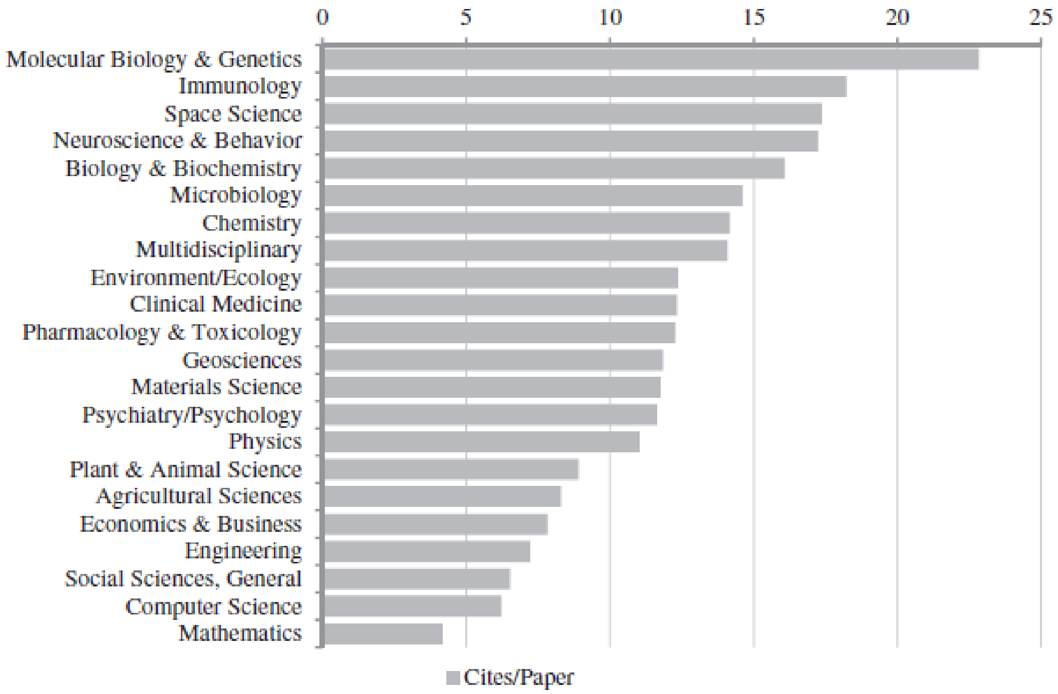
Metrics comparisons across disciplines

Scientific Field	Average *H-index*	Average Number of Authors	Individual *H-index*
Cell biology	24	3.90	15
Computer science	34	2.57	22
Mathematics	15	2.95	8
Pharmacology	39	3.08	23
Physics	30	2.66	18

Source: Adapted from analyses presented in Harzing (2010).

Example

Average number of cites per paper in a number of fields (Essential Science Indicators).



Author's elaboration on Clarivate Analytics data

Note: Last updated May 2018.

Scientific impact: data & ICT

- Indicators
  - ✓ *N. of (FAIR) data content, open source data/software*
  - ✓ *N. of users/downloads*
  - ✓ *Time spent in producing data or ICT/ time saved to reproduce or process data*
  - ✓ *Yearly salary of scientists*
- Tools
  - ✓ *Mandatory citation system for data and ICT tools*
  - ✓ *Users surveys (users communities)*
  - ✓ *Tracking of dowloads*

Education impact

- Indicators
  - ✓ *N. of early career students/technical staff*
    - origin and destination
    - skills acquired
    - Short-term/long-term
  - ✓ *N. or attendees to trainings, workshops, summer schools by origin and duration of stay*
  - ✓ *Travel costs*
  - ✓ *Salary premium over a lifetime career*
  - ✓ *Control group*
- Tools
  - ✓ *Tracking system of students/Alumni*
  - ✓ *Systematic surveys to track career paths and wage development*
  - ✓ *Systematic surveys to control group (ethics and data protection management)*

Example

Average return on tertiary education(%)

Country	Harmon, Oosterbeek, and Walker (2003), 1995	Blöndal, Field, and Girouard (2002), 1999–2000	Boarini and Strauss (2007), 2001
Austria	6.8	–	6.4
Denmark	5.6	11.3	9.1
Finland	8.7	–	7.8
France	7.8	14.8	9.0
Germany	8.8	8.7	6.3
Ireland	11.3	–	13.1
Italy	6.9	6.5	5.1
Netherlands	5.7	12.3	6.2
Portugal	9.7	–	12.2
Spain	7.8	–	5.7
United Kingdom	10.4	16.1	12.0

Source: Florio et al. (2016), adapted from cited sources.

Technological spillover and innovation

- Indicators
  - ✓ *N. of industrial suppliers*
    - Value of contract
    - Year of contract
    - Technological classification of contract (high-medium-low)
  - ✓ *N. of industrial users or collaborative projects with industry*
  - ✓ *N. of spin-offs/start-ups*
  - ✓ *Survival rate of spin-offs/start-ups*
  - ✓ *Incremental profit for new products/services/processes*
  - ✓ *Patents*
  - ✓ *Patents citations (backword and foreword)*

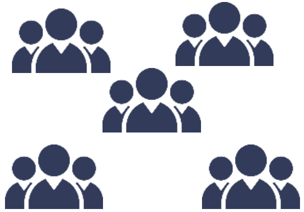
- Tools
  - ✓ *Systematic surveys to companies (with control groups)*
  - ✓ *Systematic surveys to start-ups and spin-offs (e.g. NASA spinoff https://spinoff.nasa.gov/)*
  - ✓ *Analysis of balance sheets (e.g. Orbis database)*
  - ✓ *Tracking of patents (e.g. PATSTAT)*

Cultural and outreach

- Indicators
  - ✓ *N. of physical and virtual visitors*
  - ✓ *N. of events, communication and dissemination products and related users*
  - ✓ *Origin and duration of stay for physical visitors*
  - ✓ *Travel costs*
  - ✓ *Time spent for virtual visits (website/social media)*
- Tools
  - ✓ *Tracking n. of visitors*
  - ✓ *Survey to visitors*
  - ✓ *Media tracking*
  - ✓ *Web analytics*

Science as a public good

- Indicators
  - ✓ *Contribution by Member States*
  - ✓ *Taxpayers by Member States*
  - ✓ *Willingness to pay for science*



- Tools
  - ✓ *Surveys to citizens to assess their willingness to pay*

References

Carrazza, Stefano, Alfio Ferrara, and Silvia Salini. 2016. “Research infrastructures in the LHC era: A scientometric approach.” *Technological Forecasting and Social Change*, 112, 121–133.

Florio, Massimo, Stefano Forte, Chiara Pancotti, Emanuela Sirtori, and Silvia Vignetti. 2016. *Exploring Cost-Benefit Analysis of Research, Development and Innovation Infrastructures: An Evaluation Framework*. arXiv:1603.03654.

Florio, Massimo, *Investing in Science. Social Cost-Benefit Analysis of Research Infrastructures*, MIT Press, forthcoming.

Martin, Ben R. 1996. “The use of multiple indicators in the assessment of basic research.” *Scientometrics*, 36(3), 343–362.

Martin, Ben R., and Puay Tang. 2007. *The Benefits from Publicly Funded Research*. Science Policy Research Unit, University of Sussex, Brighton, UK.

Harzing, Anne-Wil. 2010. *Citation Analysis across Disciplines: The Impact of Different Data Sources and Citation Metrics*. University of Melbourne.

THANK YOU

vignetti@csilmilano.com