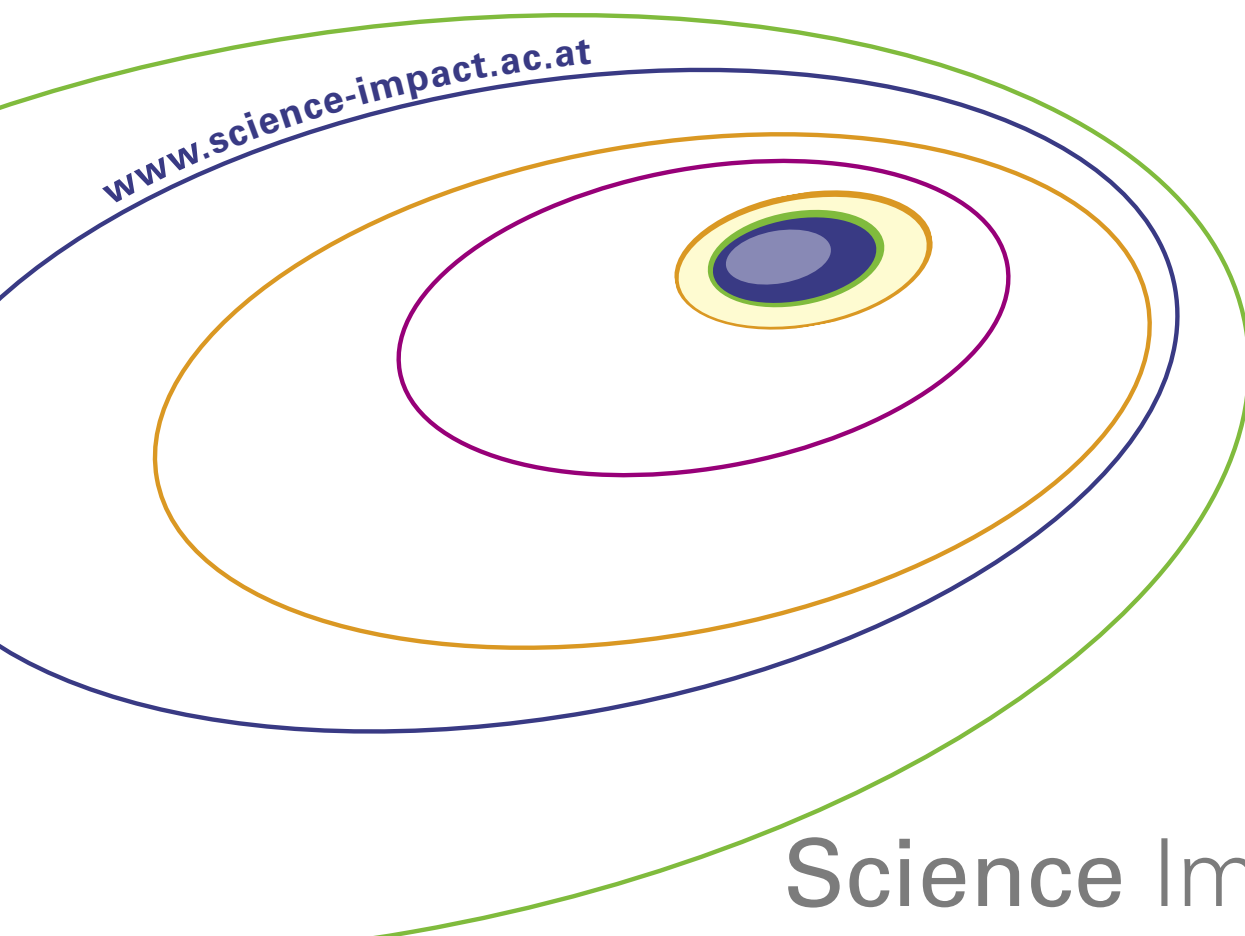




Science Impact

Rethinking the Impact of Basic Research
on Society and the Economy

International Conference
10–11 May 2007, Vienna

CONTACT & COMMUNICATION

If you have any questions concerning the Science Impact Conference,
please write an E-mail to science.impact@fwf.ac.at or via postal service to:

Austrian Science Fund (FWF)

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Science Impact

Rethinking the Impact of Basic Research
on Society and the Economy

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Thursday, 10th May 2007

08:00 – 09:00 Registration

Welcome

09:00 – 09:30 Christoph Kratky, Austrian Science Fund
Ian Halliday, European Science Foundation

Opening Statements

09:30 – 10:00 Johannes Hahn, Federal Ministry of Science and Research
Werner Faymann, Federal Ministry of Transport, Innovation
and Technology
Günther Bonn, Austrian Council for Research and
Technology Development

Keynotes

The Impact of Basic Research on Society and the Economy

10:00 – 10:30 Karl Aiginger, Austrian Institute of Economic Research
10:30 – 11:00 Haim Harari, Weizmann Institute of Science
11:00 – 11:30 Break
11:30 – 12:00 Sheila Jasanoff, Harvard University
12:00 – 14:00 Lunch

Session A

The Impact of Basic Research: Theory, History, Expectations

14:00 – 14:15 Herbert Gottweis, University of Vienna and FWF (Chair)
14:15 – 14:45 Andrew Webster, University of York
14:45 – 15:15 Joel Mokyr, Northwestern University
15:15 – 15:45 Luc Soete, UNU-MERIT
15:45 – 16:15 Break
16:15 – 17:15 Discussion including Early Stage Researchers

Reception in the Vienna City Hall

19:00 Open-ended

08:00 – 09:00 Registration

Session B

Funding Models and their Influence on the Impact of Basic Research

09:00 – 09:15 Erik Arnold, Technopolis (Chair)
09:15 – 09:45 Ian Halliday, European Science Foundation
09:45 – 10:15 Susan Cozzens, Georgia Institute of Technology
10:15 – 10:45 Chris Mombers, Technology Foundation STW
10:45 – 11:00 Break
11:00 – 12:00 Discussion including Early Stage Researchers
12:00 – 13:30 Lunch

Session C

Scope, Limits and Role of Impact Evaluation

13:30 – 13:45 Helga Nowotny, Vienna Center for Urban Knowledge Management (Chair)
13:45 – 14:15 Ben Martin, University of Sussex
14:15 – 14:45 Benoit Godin, INRS (Montreal)
14:45 – 15:15 Wolfgang Polt, Joanneum Research
15:15 – 15:45 Break
15:45 – 16:45 Discussion including Early Stage Researchers

Conference Summary

16:45 – 17:15 Stefan Kuhlmann, University of Twente

Round Table

17:15 – 17:45 Chairs ABC, Speakers ABC
17:45 – 18:00 Break

Closing Event

The Beauty of Basic Research: Computers Explore Musical Expressivity

18:00 – 19:00 Gerhard Widmer, University of Linz
Erika Chun, Vienna



Christoph Kratky

President of the Austrian Science Fund, AT



“The discussion
about the relevance
of basic scientific
research is pandemic,
and it is anything but
trivial.”

It is my great pleasure to welcome you on behalf of the Austrian Science Fund (FWF) to the international conference “Science Impact – Rethinking the Impact of Basic Research on Society and the Economy” hosted by the FWF in cooperation with the European Science Foundation (ESF).

All across Europe, it is appreciated that research is one of the foundations of technological innovation and hence is a key to meeting the challenges of global competition. However, this beneficial property is often only attributed to applied research, where the economic impact is obvious. Basic research, on the other hand, has the air of being a luxury for extravagant scientists who indulge in their hobbies at taxpayer’s expense. This prejudice is particularly prevalent towards those disciplines where economic exploitation of scientific results is unlikely, such as in the humanities. As we all know, utility is easily confused with benefit.

The FWF is Austria’s central funding agency for basic research. Our key value is scientific quality, i.e. we consider a research project worth taxpayer’s money if scientific excellence is attributed to the project through an international reviewing process. It is evident that this approach is valid and relevant for the scientific community, but it is much less obvious that society shares this attitude. Indeed, the discussion about the relevance of basic scientific research is pandemic, and it is anything but trivial. Its results are of immediate relevance to politics, economics, funding agencies and, last but not least, to the scientific community.

This conference is an invitation to everybody to participate in the discussion on the impact of basic research by contributing examples and ideas.

Christoph Kratky

Ian Halliday

President of the European Science Foundation, FR
and Chief Executive of the Scottish Universities
Physics Alliance, Edinburgh UK

Across the globe science and innovation are seen as the way to advance wealth, health and prosperity. The universities are seen as key players in generating new knowledge. The challenge for governments and research and innovation funding agencies is "How do we optimise our investment between long term blue sky research with unpredictable wealth creation outcomes, with funding high risk ideas with commercial or technological promise and with forcing the development of technology needed by society; all the time avoiding government funding of R&D that firms should fund privately."

This is a challenging managerial problem for companies and governments. There are a wide variety of assumptions and models on view across Europe and elsewhere. These models are often in implicit or explicit conflict with assumptions made elsewhere in government: state aid constraints versus government driven innovation, entrepreneurial universities versus state controlled universities, government defining societal needs versus the market knows best, ...

In this meeting I hope we can explore these assumptions and their consequences. How can Europe in particular regain its appetite for innovation and wealth creation shown in the 18th and 19th centuries? Where are the real barriers?

Ian Halliday



"How can Europe in particular regain its appetite for innovation and wealth creation shown in the 18th and 19th centuries?"

Introduction

Goal

The goal of the event is to explore how and when the reciprocal interactions between basic research, society and the economy take place. The conference will also examine methods for evaluating and reinforcing the impact of basic research, addressing these topics from a theoretical and historical viewpoint. In addition, the conference is aimed at stimulating public discussion and promoting awareness of the issues.

Programme

The planned programme includes presentations from representatives of major research organisations and high-level policy makers as well as from researchers engaged in the study of the impact of basic research.

Structure: Three keynote speeches followed by three sessions, each focussing on a particular area and consisting of three presentations followed by a panel discussion with chair, speakers and Early Stage Researchers and an open discussion.

Scientific Committee

Erik Arnold, Technopolis

Herbert Gottweis, University of Vienna and FWF

Stefan Kuhlmann, University of Twente

Alexis-Michel Mugabushaka, European Science Foundation

Helga Nowotny, Vienna Center for Urban Knowledge Management

Wolfgang Polt, Joanneum Research

Organising Committee

Reinhard Belocky, FWF

Stefan Bernhardt, FWF

Alexander Damianisch (Project Management), FWF

Gerhard Kratky (Chairman), FWF

John Marks, ESF

Rudolf Novak, FWF

Falk Reckling, FWF

Marc Seumenicht, FWF



Gerhard Kratky

Chairman of the Conference and
General Manager of the Austrian Science Fund, AT

The aims of this conference are twofold and we therefore address two main target groups, eminent members of relevant parts of the international scientific community and important stakeholders shaping the perception of science in the society.

First of all we want to provide a forum to social scientists to give a state of the art overview of how the impact of basic science is interpreted nowadays. More than 60 years have elapsed since Vannevar Bush's report on "Science – The Endless Frontier" and 10 years ago Donald E. Stokes published his ideas in "Pasteur's Quadrant". We want to evaluate these concepts in the newest scientific context. We are proud to present here in Vienna a list of speakers, comprising the most competent scientists in the field of science theory.

We also want to draw the attention on the importance of basic research for the development of society and for its impact on the economy and would like to stimulate the public discussion how basic research shapes life. Needless to say that the societal impact of basic research can also raise ambivalent notions. We therefore approach politicians, media representatives and managers of research funding organisations to participate actively and address all issues directed at raising the awareness of the relevance of basic research in modern society.

The conference will bring together different competencies and interests. This interaction of specialists from fields such as science theory, history, research funding, output measurement, research evaluation, economics and politics is planned to be the added value of this conference.

I am confident that our conference "Science Impact – Rethinking the Impact of Basic Research on Society and the Economy" will meet the expectations of all participants and I would like to wish all of you a pleasant time in Vienna.

Gerhard Kratky



"We want to stimulate the public discussion and to emphasise the important role of basic research for the development of society and for its impact on the economy."

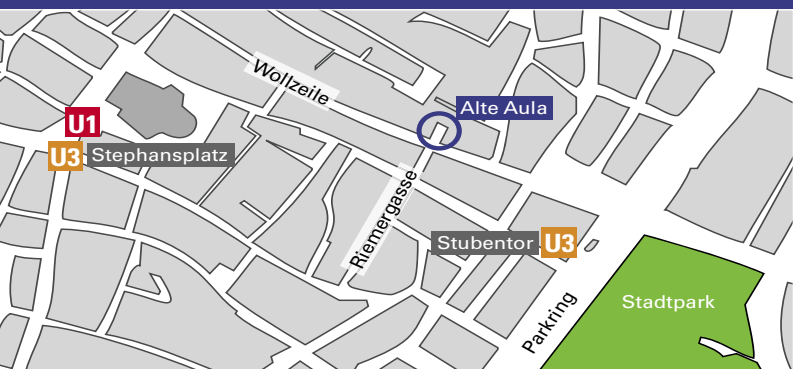


Translation for the morning of May 10 will be provided.

Location

The event takes place in the Alte Aula, located right in the heart of Vienna. The venue is surrounded by some of the most famous sights of Vienna, including the St. Stephen's Cathedral, the Ringstrasse with its remarkable buildings, the Hofburg, the Vienna State Opera and many more. Further details and information can be found on the conference website: www.science-impact.ac.at

The Alte Aula can be reached on foot in five minutes from the U1/U3 subway station "Stephansplatz". Alternatively, you can walk the Wollzeile street in the direction Stephansplatz for about five minutes from the U3 subway station "Stubentor". Using the public transportation, you can get to the Alte Aula by the bus line 1A, which stops right in front of the Alte Aula. The bus line A1 runs from the station "Stubentor" (U3) to the station "Schottentor" (U2) and back.



Cultural Events

We want to draw your attention to the fact, that apart from a lot of cultural opportunities, the event will precede the opening of the international acclaimed theater and music festival "Wiener Festwochen 2007" on the evening of May 11, 2007: www.festwochen.at. Further details and information on cultural events can be found on the conference website: www.science-impact.ac.at

Registration

The registration for the conference is handled by AUSTROPA INTERCONVENTION. Please visit the registration button at: www.science-impact.ac.at

Please consider the registration fee:
EURO 300 per participant
EURO 200 for early booking (till March 19th)
EURO 50 for students

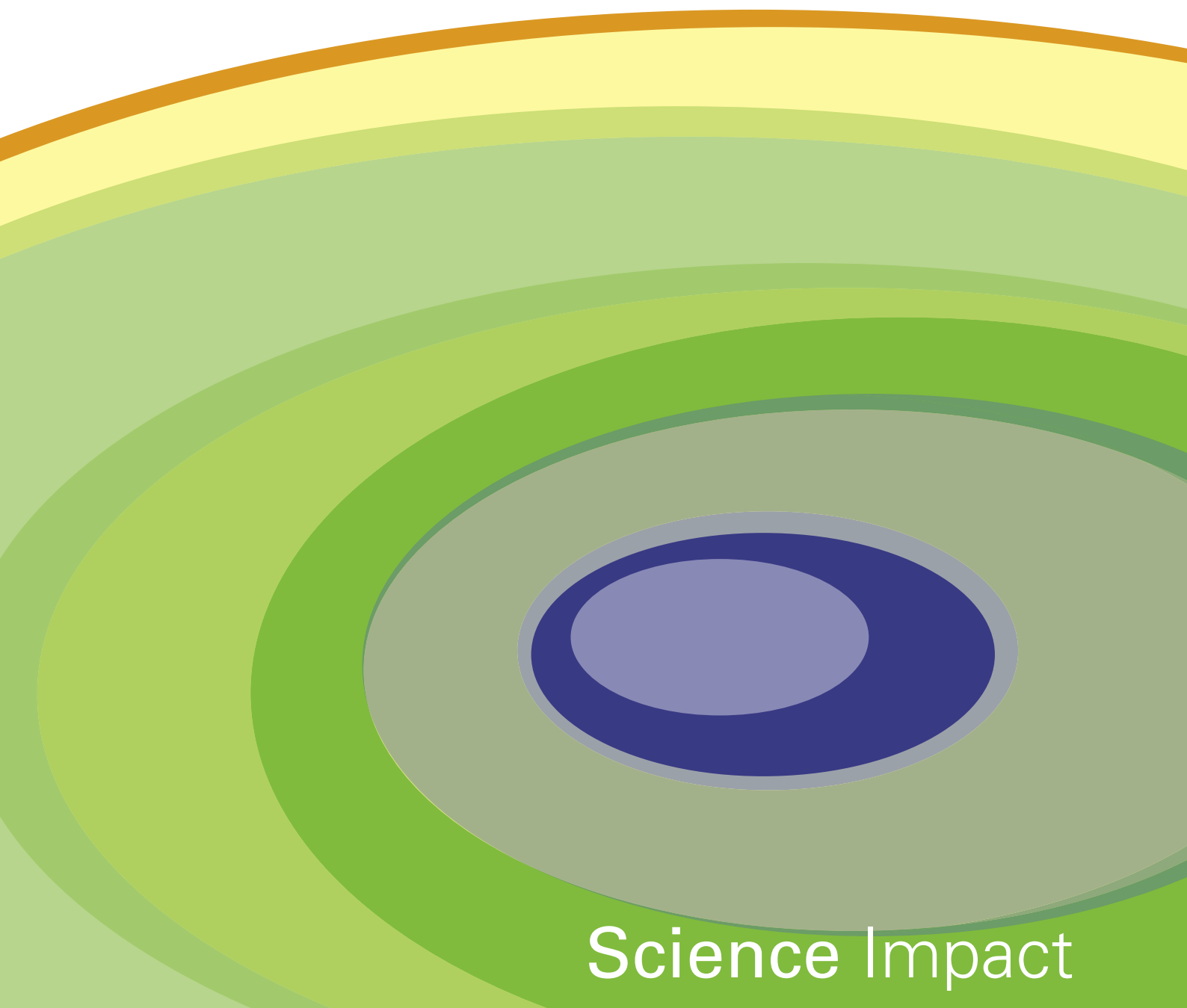
Should you have any questions, please contact:
Alexander Damianisch
science.impact@fwf.ac.at
Tel.: +43/1/505 67 40-8112
Fax.: +43/1/505 67-39

Accommodation

AUSTROPA INTERCONVENTION is appointed as the official housing office for the Conference. AUSTROPA INTERCONVENTION offers the full range of travel agency services such as hotel reservations, sightseeing tours, cultural tickets, social events, ...

Please visit the accommodation button at:
www.science-impact.ac.at

Should you have any questions, please contact:
Alfred Kerschenbauer
science.impact@interconvention.at
Tel.: +43/1/588 00-510
Fax: +43/1/588 00-520



Science Impact

KEYNOTES



Karl Aiginger



Austrian Institute of Economic Research (WIFO), AT
E-mail: karl.aiginger@wifo.ac.at

The Impact of Basic Research on Economic Growth and Employment

Current Positions:

- Director of Austrian Institute of Economic Research (WIFO)
- Professor of Economics at the Vienna University of Economics and Business Administration, Department of Economics
- Professor of Economics at the University of Linz

Employment Record:

- Economist of WIFO (since 1970)
- Managing Editor of *Empirica* – Austrian Economic Papers (1975-1992)
- Visiting Professor at Stanford University, CA, USA (1982)
- Deputy Director of WIFO (1984-1987)
- Visiting Professor at MIT, Boston, Mass., USA (1991)
- Visiting Professor at UCLA, CA, USA (1997)
- Supervising Board of ÖIAG (Holding Company of Industrial Firms) (1993-2000)
- Professor at the University of Linz, Austria, Guest Professor, Honorary Professor; Industrial Economics & Economics (1992-2006)
- Deputy Director of WIFO (1996-1998)
- Professor at the Graduate School of Business, Stanford University GSB and IIS, Stanford University (2002)
- Professor of Economics at the Vienna University of Economics and Business Administration, Department of Economics (since 2006)
- Deputy Director of WIFO (2002-2005)
- WIFO director (since 1st of March 2005)

European economic growth has been disappointingly low over the past years relative to the US as well as relative to historical experience. Consequently unemployment is persistently high in Europe. The economic growth of high income countries depends on research, education, lifelong learning and the adoption of new technologies. This lecture emphasizes the impact of research, be it basic or applied, private or public on economic growth. Innovation policy is an increasingly important part of economic policy, since basic research has characteristics of a public good and applied research benefits not only the specific firm investing, but also other firms, countries and generations.

Key areas of research:

- Industrial Economics and Industrial Policy
- Competitiveness of firms, industries, countries
- Economic strategy and policy

Other fields of activities:

- Research fellow at European Forum at Stanford University
- head manager and contributor to European Competitiveness Reports since 1998 (European Commission)
- Lecturing at University of Vienna; University of Economics and Business, Vienna; Technical University, Vienna; University of Hunan (China); Webster University
- Committee member: EARIE and EUNIP-Conferences
- Head of Network "Wettbewerbsfähigkeit in der Wissensgesellschaft"

Editor:

Journal of Industry, Competition and Trade (JICT), jointly with Andre Sapir

Referee for:

Economic Journal, European Economic Review, Journal of Industrial Economics, Journal of Small Business Economics, Journal of Economics, Journal of Empirical Economics, International Journal of Industrial Organization, *Empirica* – Austrian Economic Papers



Weizmann Institute of Science, IL
E-mail: haim.harari@weizmann.ac.il

From Basic Science to Economic Value: A Necessary Path for a Modern Society

A modern economy relies heavily on science and technology. All technological developments emanate, directly or indirectly, from discoveries in basic research. It is impossible to predict which scientific fields or subfields might become useful, or when and how it might happen. First class basic research invariably leads to practical results, and any attempt to guide such research according to current needs, is guaranteed to miss the point and to prevent the discovery of totally new opportunities, phenomena and technologies. Demanding instant practical results from basic research is as silly as demanding industrial production from a baby. Yet, if there were no babies, there would have been no industrial production a generation later.

A few well known cases may demonstrate this point. The emergence of the “useless” field of number theory as the “queen of cryptography” is one such example. The role of the esoteric field of particle physics in creating Magnetic Resonance diagnostics, Tomography and the World Wide Web is another. The incredible commercial success of the Weizmann Institute, an organization exclusively dedicated to basic research, is a significant model for other Institutions dealing with fundamental science. It is based not only on scientific success, but also on an aggressive business policy regarding the utilization of “accidental” discoveries.

Basic research can also create, via the leadership of a small number of outstanding individuals, “dynasties” of first class experts in a given field, leading to clusters of academic-industrial excellence in certain areas. The modern economic world must find a way to create an efficient and carefully crafted “Academic-Industrial Complex,” without which the knowledge society cannot flourish.

It is crucial to optimize the number of different research groups, projects and topics in any given environment, be it a scientific department, an entire institution, a region or a country. Given a certain amount of funding, too few projects might not provide enough diversification of “investment.” Too many might lead to meager funding for each project. A healthy forest must have enough trees, but not too many per unit of area. A nation wishing to advance economically, must have enough children in the next generation, but not too many. Both analogies are truly representative of the needs of basic research.

- Institute Professor, Weizmann Institute Israel
- Former President (1988-2001), Weizmann Institute
- Chairman, Davidson Institute of Science Education at the Weizmann Institute of Science
- Chairman of the Management Committee, Weizmann Global Endowment Management, New York
- Chairman of the Executive Committee, Institute of Science and Technology Austria (ISTA)

Haim Harari is a fifth-generation born Israeli, who has contributed to three different fields: Particle Physics research, science education in the schools, Science Management and Policy Making.

Harari served as President of the Weizmann Institute of Science in Israel from 1988 to 2001. During his presidency, the Institute entered numerous new scientific fields, built 47 new buildings, raised one billion Dollars in philanthropic money, hired more than half of its current tenured professors and became one of the highest royalty-earning academic organizations in the world.

Harari joined the Institute staff in 1966, becoming Full Professor in 1970. He made major contributions to Particle Physics, and in 1975 was the first to synthesize the current “standard model” of six quarks and six leptons in its present form.

In the field of education, Harari served as a Dean of the Graduate School (1972-1978), and established “Perach”, a national tutoring program for underprivileged children in Israel, currently involving 32,000 undergraduates, helping a similar number of children. He served as Chairman of both the Planning and Grants Committee of Israel’s Council for Higher education (1979-85) and in 1991-2 he chaired the National Panel on Science Education, leading to a report, which has since been the blueprint for science education in Israel’s schools. His honours include membership in the Israel Academy of Sciences (1978), the Rothschild Prize in Physics (1976), the Israel Prize (1989), the “EMET” prize in Education (2004), four honorary doctorates, the “Commander Cross of the Order of Merit” presented by the President of Germany, “Cross of Honor, Science and Art, First Class” presented by Austria and the Harnack Medal of the Max Planck Society.



Sheila Jasanoff



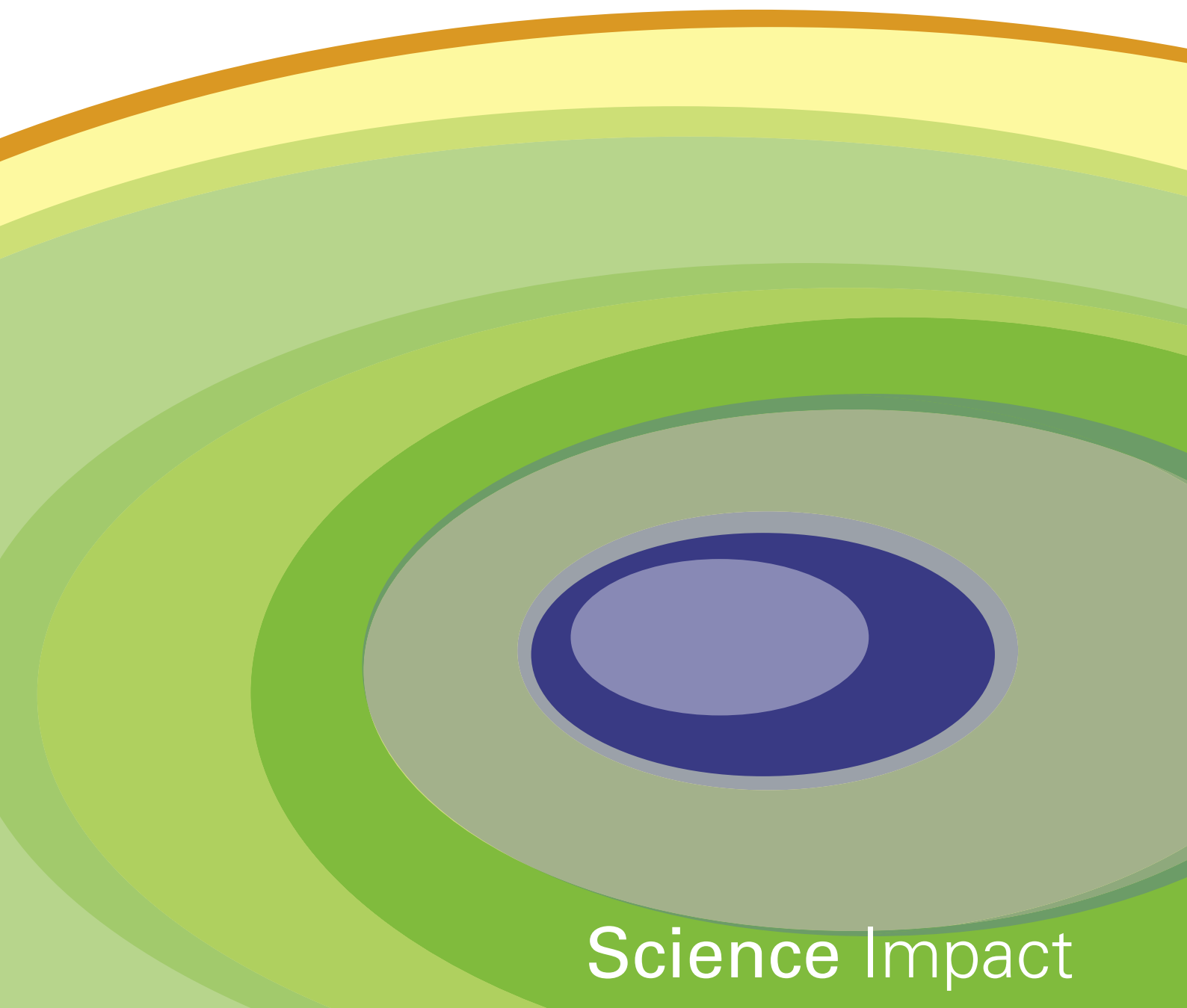
Kennedy School of Government, Harvard University, USA
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Sheila Jasanoff is Pforzheimer Professor of Science and Technology Studies. She has held academic positions at Cornell, Yale, Oxford, Cambridge, and Kyoto. At Cornell, she founded and chaired the Department of Science and Technology Studies. She has been a Leverhulme Visiting Professor at Cambridge, Fellow at the Berlin Institute for Advanced Study, and Resident Scholar at the Rockefeller Foundation's Bellagio study center. Her research concerns the role of science and technology in the law, politics, and public policy of modern democracies, with a particular focus on the challenges of globalization. She has written and lectured widely on problems of environmental regulation, risk management, and biotechnology in the United States, Europe, and India. Her books include *Controlling Chemicals*; *The Fifth Branch*; *Science at the Bar*; and *Designs on Nature*. Jasanoff has served on the Board of Directors of the American Association for the Advancement of Science and as President of the Society for Social Studies of Science. She holds an honorary doctorate from the University of Twente, as well as AB, JD and PhD degrees from Harvard University.

Frontier of Dreams: Basic Science in Society

The work of basic science is driven by mundane considerations, competition for money and space, paradigmatic and instrumental constraints, availability of human skills and labor, the resistance of nature, and the demands of time. By contrast, public and private investments in basic science are driven by grand narratives and imaginaries of progress that are sustained by wider culture and have little or nothing to do with the daily practices of science. For hundreds of years, scientifically and technologically advanced societies have worked on accountability mechanisms that ensure, or seek to ensure, responsible behavior in science's varied workplaces. Despite their flaws, peer review, publication, replication, and wrestling with nature discipline the everyday practices of science. It is in the gap between the dreams of progress and the reality of practice that failures of accountability have appeared. This talk reflects on how universities, in particular, through their commitment to educating citizens, can engage both society and science in a more responsible discourse at the frontier of dreams.

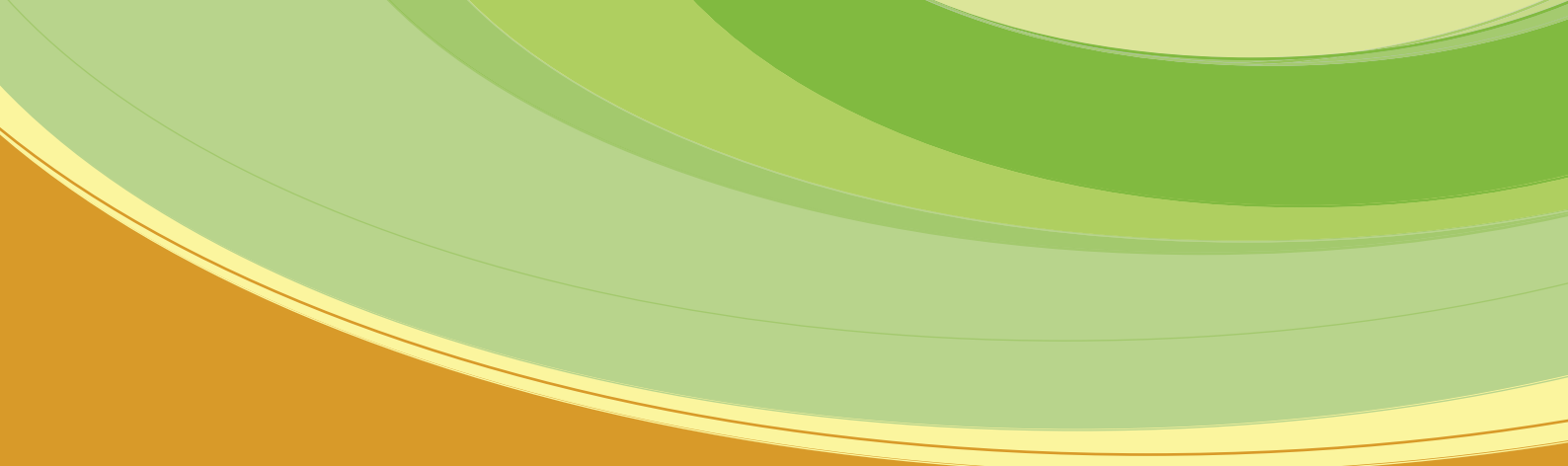
- Jasanoff, Sheila. *Designs on Nature: Science and Democracy in Europe and the United States*. Princeton University Press, 2005.
- Jasanoff, Sheila, ed. *States of Knowledge: The Co-Production of Science and Social Order*. Routledge, 2004.
- Jasanoff, Sheila, and Marybeth Long Martello, eds. *Earthly Politics: Local and Global in Environmental Governance*. MIT Press, 2004.
- Jasanoff, Sheila. „In a Constitutional Moment: Science and Social Order at the Millennium,“ in B. Joerges and H. Nowotny, eds., *Social Studies of Science and Technology: Looking Back, Ahead*, Yearbook of the Sociology of the Sciences (Dordrecht: Kluwer, 2003), pp. 155-180.
- Jasanoff, Sheila. *Science at the Bar: Law, Science, and Technology in America*. Harvard University Press, 1995; Italian translation 2001.



Science Impact

SESSION A

The Impact of Basic Research: Theory, History, Expectations



Participants

Herbert Gottweis, University of Vienna and FWF (Chair), AT

Andrew Webster, University of York, UK

Joel Mokyr, Northwestern University, USA

Luc Soete, UNU-MERIT, NL



Herbert Gottweis

Department of Political Science,
University of Vienna, AT
E-mail: herbert.gottweis@univie.ac.at



Introduction

This session focuses on theoretical and historical interpretations of science, technology, and innovation. Which factors determine the dynamics of science and technology development? How can we explain successful innovation? This session will also focus on the often difficult interaction between science and society, and its impact on the process of innovation. Under which circumstances does society clash with innovation? Which forces operate in the co-production of science and society? Furthermore, the session will explore the relationship between basic research and economic and societal development. The descriptive accuracy of the linear model of innovation will be examined. We will also discuss how political and economic expectations influence the support of basic research.

Among his publications are Gottweis H. (2006) *Argumentative Policy Analysis*, John Pierre/ E. Guy Peters (eds.), Public Policy Handbook (London: Sage), 461-479. Gottweis, H. and Prainsack B. (2006) *Emotion in Political Discourse: Contrasting Approaches to Stem Cell Governance: the US, UK, Israel, and Germany*. Regenerative Medicine, 1, 823-829. Gottweis, H. and Triendl R. (2006), *South Korean Policy Failure and the Hwang Debacle*, *Nature Biotechnology*, Vol 24, 141-143. Gottweis, H. (2005) *Between Asilomar, EMBO, the OECD, and the Europe Community: Transnationalizing Recombinant DNA Regulation*, *Science as Culture*, Vol 22. 325-338. Gottweis, H. (2005), *Governing Genomics in the 21st Century: Between Risk and Uncertainty, New Genetics and Society*, Vol 24, May, 175-193. Gottweis, H. et al. (2004), *Verwaltete Körper: Strategien der Gesundheitspolitik im internationalen Vergleich (Administrated Bodies: Health Policy Strategies in International Comparison)*. (Wien/Weimar: Böhlau Verlag, 2004). 376 pages. Gottweis, H., (1998), *Governing Molecules. The Discursive Politics of Genetic Engineering in Europe and in the United States* (Cambridge, Mass.: MIT Press). 397 pages.

Herbert Gottweis, born 1958, has been professor at the department of Political Sciences since 1998, and research associate at the BIOS Centre, London School of Economics (LSE). At the University of Vienna he directs the LIFE-SCI-ENCE-GOVERNANCE Research Platform and the TIPP Research Group. He gained his Ph.D. from the University of Vienna (1984), was a visiting student at the University of Rochester (1983), Assistant and Lecturer at the Political Science Department, University of Salzburg (1985-1997), visiting research fellow (supported by a FWF Erwin Schrödinger Stipend) at the Centre of European Studies, Harvard University (1989/90), visiting research fellow (supported by the Andrew Mellon Foundation) at MIT's program in Science, Technology, and Society (1992/93), assistant professor at the Department of Science and Technology Studies, Cornell University (1993-95). He was visiting professor at the Department of Social Studies, Hong Kong University of Science and Technology (1997) and at the Australian School of Environmental Studies, Griffith University (2004). Since 2005 he is also vice-president of the FWF.

Herbert Gottweis is the coordinator of the PAGANINI ("Participatory Governance and Institutional Innovation") project (2004-2007) funded as a STREP under the 6th EU Framework programme and he also is partner in two other 6th EU Framework programme projects (BIONET, a China-EU network on ethical governance in bio-medical research (2006-2008) and GENBanC (2006-2008), a project on biobank governance. Gottweis also directs the project "Transforming Health Policy: Biobanks, Pharmacogenetics/ Pharmacogenomics, and the Governance of Bio-medical Research" (2004-2006), and he co-directs the project "Genes without Borders" (2006-2007), a project on transnational genomics governance, both funded by the Austrian (Begleitforschungs-) ELSA GEN-AU program.



Andrew Webster



Department of Sociology, University of York, UK
E-mail: ajw25@york.ac.uk

Professor Andrew Webster is Director of the Science and Technology Studies Unit (SATSU), and Head of Department of Sociology at the University of York. SATSU undertakes research on the social and cultural implications of science and technology. He joined the Department in 1999 accompanied by his research Unit formerly located in Cambridge. He was Director of the £5m ESRC/MRC Innovative Health Technologies Programme (2001-6), is member of various national boards and committees, and recently co-ordinated and co-authored the ESRC's Research Ethics Framework implemented in 2006. He is national co-ordinator of the ESRC's new Stem Cells initiative (2005-9), and is a member of the Royal Society's Expert Working Group on health Informatics.

His research interests cover the sociology of science and technology, science policy studies, innovative health technologies and their use, the sociology of innovation, the commercialisation of research, and technology foresight. He is currently undertaking externally funded research on stem cells and the implementation of pharmacogenetics and public confidence in informatics systems. He won an ANU research fellowship in 2006 and there completed much of his forthcoming book, *Health, Technology and Society: A Sociological Critique* (Palgrave Macmillan).

Evaluative Reviews and Reports:

Biotechnologies and ICTs: Impact on Lifestyle, Lifespan and Health, A report for CRIC/ESRC, December 1999; *Bioinformatics: a technical assessment*, STOA, European Parliament, 1999; *Human Genetics: An Inventory of new and potential developments in human genetics and their possible uses*, STOA, European Parliament 2001 (co-author); *Digital healthcare: the impact of information and communication technologies on health and healthcare*, London: Royal Society. (co-author) 2006.

Going beyond the lab: mobilising basic science through socio-technical networks

Most areas of basic science today depend on developing new techniques, instruments and technology platforms to manipulate the 'natural' in new ways to provide the basis for novel and useful research. This is never a unilinear process, however, but instead one that reflects a range of intersections with existing applied science and professional and commercial networks. Drawing on examples from bioscience, especially the field of stem cells research in which the author is working, this paper explores these intersections to trace the 'impact' of embryonic stem cells on innovation.

Contested Futures: A sociology of prospective techno-science (Ashgate: Aldershot) co-editor, 2000; *New Medical Technologies and Society: Reordering Life* (Cambridge, Polity Press) 2004; *New Technologies in Health Care: Challenge, Change and Innovation* (Palgrave Macmillan) 2006; (Editor) *Health Technology and Society: A Sociological Critique* (2007) (Palgrave Macmillan)

Andrew Webster and Brian Rappert, (2000) "The commercialisation of Science" *Knowledge, Economy and Society* vol 45, 41-65; Andrew Webster, (2000) "Intellectual Property" – Invited contribution to S. Jasanoff, (ed) *International Encyclopaedia of the Social and Behavioural Sciences*, Elsevier; Richard Hull, William Kaghan and Andrew Webster (co-editors) (2000), Special Issue of *Technology Analysis and Strategic Management: The Intersection of Innovation Studies and Critical Management Studies*, vol 12, No. 3; Andrew Webster, (2002) "Innovative health technologies and the social: redefining health, medicine and the body" *Current Sociology*, vol .50, pp 443-458; Andrew Webster, (2002) "Risk and Innovative Health Technologies: Calculation, Interpretation and Regulation", in A. Webster (ed.) Special Issue of *Health Risk and Society*, vol 4, no. 3, 221-27; Andrew Webster, David Charles and Brian Rappert, (2003) "Controlling intellectual property across the high-tech frontier" in Blackburn, R. (ed.) *Intellectual Property and Innovation Management in Small Firms*, (Routledge: London) pp 105-122; Andrew Webster, (2004) "Health Technology Assessment: a Sociological Commentary on Reflexive Innovation", *International Journal of Technology Assessment in Health Care*, vol 20, No 1, pp 1-6; Andrew Webster (2004) "Risk, science and policy: researching the social management of uncertainty" *Policy Studies*, vol 25, No 1, pp5-15; Andrew Webster et al. (2004) *Integrating Pharmacogenetics into Society: In Search of a Model*, *Nature Reviews: Genetics* vol 5, 663-69; Andrew Webster (2005) *Social science and a post-genomic future: alternative readings of genomic agency*, *New Genetics and Society*, vol 24, no 2, pp 227-237; Andrew Webster, (2006) *Social science ethics: the changing context for research*, *Clinical Ethics*, vol 1: 39-41; Andrew Webster (2007) *Crossing Boundaries: STS in the Policy Room, Science, Technology & Human Values* (in press)

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Useful Knowledge, Science, and the Origins of Economic Growth

It is widely understood that the Industrial Revolution in the late eighteenth century constitutes a watershed in the economic history of the world. It marks the beginning of a process of sustainable economic growth that rested on the growth and dissemination of useful knowledge. The role of science in generating modern economic growth has been discussed widely, but the economics of science and technology is too often taken out of the context of eighteenth century science and scientists and the incentives and constraints they faced. Moreover, the exact interaction between science and technology is rarely modelled. In this paper I elaborate on some of the concepts I introduced in earlier work, specifically in the widening and deepening of the epistemic base of technology and how these led to more sophisticated technology and economic growth in the nineteenth century. I also propose to re-examine the role of science and scientists in the process by comparing them to modern-day open-source developers, in which the pay-offs to success are more reputational than pecuniary.

Joel Mokyr is the author of *Why Ireland Starved: An Analytical and Quantitative Study of the Irish Economy*, *The Lever of Riches: Technological Creativity and Economic Progress*, *The British Industrial Revolution: An Economic Perspective* and his most recent *The Gifts of Athena: Historical Origins of the Knowledge Economy*. His books have won a number of important prizes including the Joseph Schumpeter memorial prize (1990), the Ranki prize for the best book in European Economic history and more recently the Donald Price Prize of the American Political Science Association.

He is currently working on a new book, *The Enlightened Economy* to be published by Yale University Press and Penguin in 2007. He has authored over 70 articles and books in his field. He has served as the senior editor of the *Journal of Economic History* from 1994 to 1998, and is the editor in chief of the *Oxford Encyclopedia of Economic History* (published in July 2003) and the Princeton University Press *Economic History of the Western World*.

Joel Mokyr is the Robert H. Strotz Professor of Arts and Sciences and Professor of Economics and History at Northwestern University and Sackler Professor (by special appointment) at the Eitan Berglas School of Economics at the University of Tel Aviv. He specializes in economic history and the economics of technological change and population change. He served as President of the Economic History Association in 2003-04, and is a director of the National Bureau of Economic Research and a member of its executive committee. He served as chair of the Economics Department at Northwestern University between 1998 and 2001 and was a fellow at the Center for Advanced Studies in the Behavioral Sciences at Stanford between Sept. 2001 and June 2002.

Professor Mokyr has an undergraduate degree from the Hebrew University of Jerusalem and a Ph.D. from Yale University. He has taught at Northwestern since 1974, and has been a visiting Professor at Harvard, the University of Chicago, Stanford, the Hebrew University of Jerusalem, the University of Tel Aviv, University College Dublin, and the University of Manchester. He is a fellow of the American Academy of Arts and Sciences, a foreign fellow of the Royal Dutch Academy of Sciences and the Accademia Nazionale dei Lincei. In 2006 he was awarded the biennial Heineken Prize by the Royal Dutch Academy of Sciences for a lifetime achievement in historical science. He is President Elect of the Midwest Economics Association. He is currently working on the intellectual and institutional origins of modern economic growth and the way they interacted with technological elements. His current other research is an attempt to apply insights from evolutionary theory to long-run changes in technological knowledge and economic history.



Luc Soete



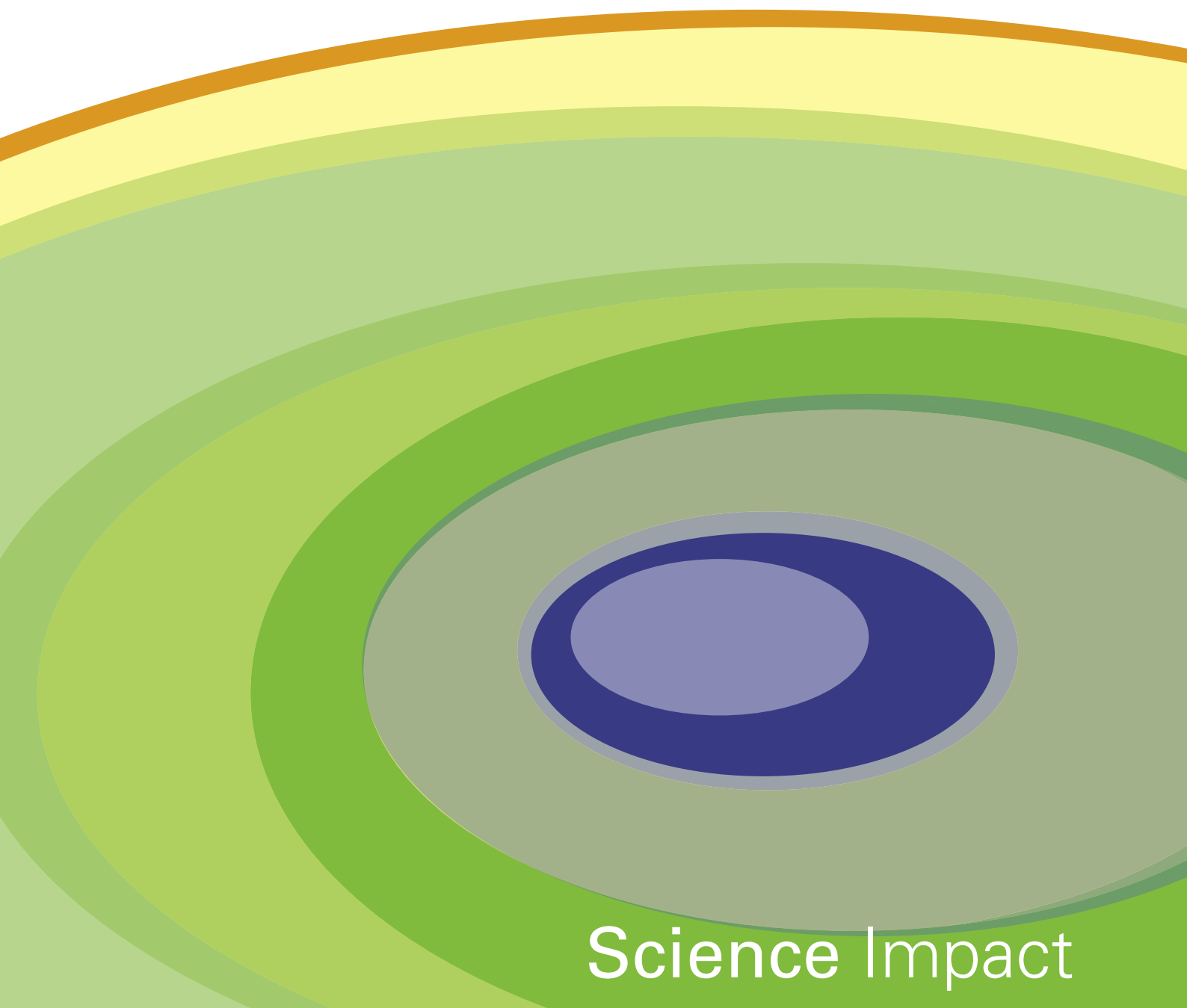
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Luc Soete is joint Director of the United Nations University Institute for New Technologies (UNU-INTECH) and the Maastricht Economic Research Institute on Innovation and Technology (MERIT), since 2005, overseeing the integration of the two institutes to form the new research and training centre, UNU-MERIT. He was the founding director of MERIT, which he set up in 1988, and Professor of International Economics (on leave) at the Faculty of Economics and Business Administration, University of Maastricht. He was appointed member of the Dutch scientific advisory body Adviesraad voor Wetenschap en Technologie (AWT), in January 2004. Before coming to Maastricht in 1986, he worked at the Department of Economics of the University of Antwerp, (UFSIA), the Institute of Development Studies and the Science Policy Research Unit, both at the University of Sussex, and the Department of Economics at Stanford University. Professor Soete completed his first degrees in economics and development economics at the University of Ghent, Belgium, before obtaining his DPhil in economics at the University of Sussex. His research interests cover the broad range of theoretical and empirical studies of the impact of technological change, in particular new information and communication technologies on employment, economic growth, and international trade and investment, as well as the related policy and measurement issues.

“Recherche sans frontières”: when science turns global

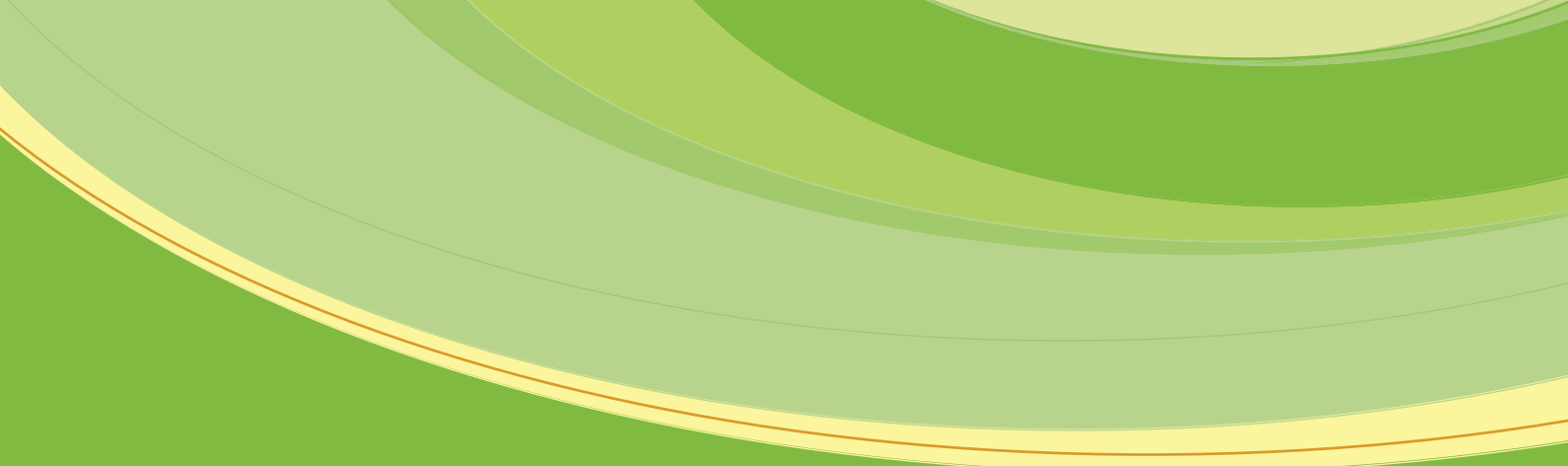
Contrary to national policy belief – typified e.g. by the emphasis in the EU on the so-called Barcelona 3% R&D investment norm – that research and science policy is essentially a local affair, i.e. consisting primarily of national funding and fiscally supporting research at domestic universities, public and private research laboratories, in the modern world of the internet and digital libraries, science is increasingly a global affair. For most countries in the world, the contribution of domestic sources to the global stock of academic knowledge is relatively small, and its contribution to domestic productivity growth equally small. By contrast, there is little doubt that the largest part of world wide productivity growth over the last ten years has been associated with an acceleration in the diffusion of technological change and global access to so-called codified knowledge. The role of information and communication technologies has been instrumental in this process, as has been that of more capital and organisational embedded forms of technology transfer such as foreign direct investment. There remains of course a huge world-wide concentration of research investments in a relatively small number of rich countries/regions, but it is important, certainly from a national science and technology policy perspective, to realize that such activities, whether privately or publicly funded are increasingly becoming global in focus. For private firms given the higher risks involved in developing new products for global markets, firms today will often prefer to license such technologies or alternatively outsource the most risky parts to small, science based, high tech companies which operate at arms length but can be taken over, once successful. Not surprisingly, in most OECD countries, the large R&D intensive firms appear today less interested in increasing their R&D investments in OECD countries than in rationalising them or where possible reducing the risks involved in carrying out R&D by collaboration with others, sometimes through publicly sponsored or enabled programmes or through so-called open innovation collaboration.

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Science Impact

SESSION B
Funding Models and their Influence on the Impact of Basic Research



Participants

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Ian Halliday, European Science Foundation, FR

Susan Cozzens, Georgia Institute of Technology, USA

Chris Mombers, Technology Foundation STW, NL



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Introduction

Anyone seeking to benchmark the effectiveness of research funding will encounter a wide variety of established models. Cases of best practise will be presented in terms of maximisation of the social and economic impact of basic research. New approaches are growing in importance, aimed at the productive use of the divide between science and society. As an example, researchers from different disciplines are forming new teams working at the interfaces between traditional structures. The funding schemes, both project-based and institutional, that make such work possible will be illustrated by success stories and the principles behind them will be discussed. The conference will also investigate how to allocate the responsibility for research funding among the different levels of local, regional and national government and the European Union for maximum impact.

Erik Arnold is the group Managing Director of Technopolis, based in the UK. He works on: evaluation, science, technology and innovation policy; industry policy; regional and industrial development; benchmarking; and the design and management of policies and programmes. He formerly worked at the Science Policy Research Unit, the University of Sussex, the European Commission and as a management consultant with Booz.Allen & Hamilton. He holds a BA (Hons) in English literature, an MSc in Science & Technology Policy and a DPhil in economics, all from the University of Sussex. He is an Honorary Fellow of the Centre for Research in Innovation Management (CEN-TRIM), University of Brighton. He is bilingual (Norwegian/Swedish and English) and also works in German and French.



Ian Halliday



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Science and Funding Models

Professor Ian Halliday, an outstanding physicist in the field of particle physics, is President of the European Science Foundation and Chief Executive of the Scottish Universities Physics Alliance, Edinburgh UK. His publications include numerous papers on theoretical particle physics in "Nuclear Physics" and "Physics Letters".

Former Chief Executive of the UK's Particle Physics and Astronomy Research Council, he was the prime driver for the e-science/GRID activity in the UK and led the initiative to network funding agencies to put the international Linear Collider in place. He served on the CERN Council for 7 years. He served in a number of international scientific advisory committees, including the senior advisory committee of the Directorate General Research of the European Commission (EURAB). He is also currently on the FRA Board of FermiLab in the USA.

Most active areas of science are becoming more competitive, more organised with greater infrastructure requirements. Funding Agencies have to address these problems and put structures in place that accept these realities. Thus we have tensions between small scale funding of individuals and large, long-term scale funding of infrastructure. There are tensions between funding mature areas and encouraging new areas. There are tensions between the comfort of national systems and the threat of European competition.

I will use examples from my experiences to illuminate these problems and suggest solutions within European and national contexts.



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Maximizing Social Impact through Science and Technology: Best Practices

Most of what passes as “socioeconomic impacts” of innovation programs are actually impacts in the economy, for example, growth of firms, expansion of industries, or increase in gross domestic product. When economic growth is not the expected outcome, environmental sustainability is the next likely goal to appear in this category, with measures of success like reductions in energy use or greenhouse gases released. The “socio” in “socio-economic” sometimes appears to be a residual category, gathering together any goals that are not obviously economic or environmental.

Because of the intense attention devoted to the other categories, the effectiveness of innovation programs aimed at social goals is seldom examined. The paper will argue that outcome measures are generally available for a variety of social impacts, but the evaluation community in general lacks logic models that connect S&T policies and programs to these outcomes. In this matter, evaluation practice reflects the state of program theory. This paper will make some general points about such logic models by examining best practice in using science and technology policies and programs to reach three illustrative social goals: health, equity, and social cohesion.

Susan Cozzens’ Ph.D. is in sociology from Columbia University (1985) and her bachelor’s degree from Michigan State University (1972, summa cum laude). She is a recipient of Rensselaer Polytechnic Institute’s Early Career Award, a member of Phi Beta Kappa and Phi Kappa Phi, and a Fellow of the American Association for the Advancement of Science.

Dr. Cozzens is past editor of *Science, Technology, & Human Values*, the journal of the Society for Social Studies of Science (4S), and has served on councils and committees for several professional societies. She is author of *Social Control and Multiple Discovery in Science: The Opiate Receptor Case* (SUNY Press, 1990), and co-editor of *Theories of Science in Society* (with Thomas F. Gieryn; Indiana University Press, 1991); *The Research System in Transition* (with Peter Healey, Arie Rip, and John Ziman; Kluwer, 1991); and *Invisible Connections: Instruments, Institutions, and Science* (with Robert Bud; SPIE, 1992). Her work has appeared in *Issues in Science and Technology*, *Policy Studies*, *The Journal of Technology Transfer*, *Evaluation and Program Planning*, *Neuroscience*, *Social Studies of Science*, *Knowledge: Creation, Diffusion, Utilization*, *Scientometrics*, *Science and Public Policy*, and *Research Policy*, and she has contributed chapters to a dozen books. She is co-editor of *Research Evaluation*.

Susan E. Cozzens is Professor of Public Policy and Director of the Technology Policy and Assessment Center in the School of Public Policy at the Georgia Institute of Technology. Her current research is on science, technology, and inequalities, and she is active internationally in developing methods for research assessment and science and technology indicators.

From 1995 through 1997, Dr. Cozzens was Director of the Office of Policy Support at the National Science Foundation. The Office coordinated policy and management initiatives for the NSF Director, primarily in peer review, strategic planning, and assessment.

Dr. Cozzens has served as a consultant to the Committee on Science, Engineering, and Public Policy of the National Research Council, Office of Science and Technology Policy, National Science Foundation, Institute of Medicine, Office of Technology Assessment, General Accounting Office, National Cancer Institute, National Institute on Aging, the National Institutes of Health, and the National Institute on Occupational Safety and Health, and on advisory committees for the American Association for the Advancement of Science (Liberal Education and the Sciences, EPSCOR Evaluation), the National Academy of Sciences (NSF Decision-making for Major Awards), and the Office of Technology Assessment (Human Genome Project). She has been an invited speaker on science policy and research evaluation at the Ministry for Research and Technology in France, the Research Council of Norway, the Institute for Policy and Management in Beijing, and the Fundamental Science Foundation of Sao Paulo, Brazil, and is a former chair of the Committee on Science, Engineering, and Public Policy of the American Association for the Advancement of Science.



Chris Mombers



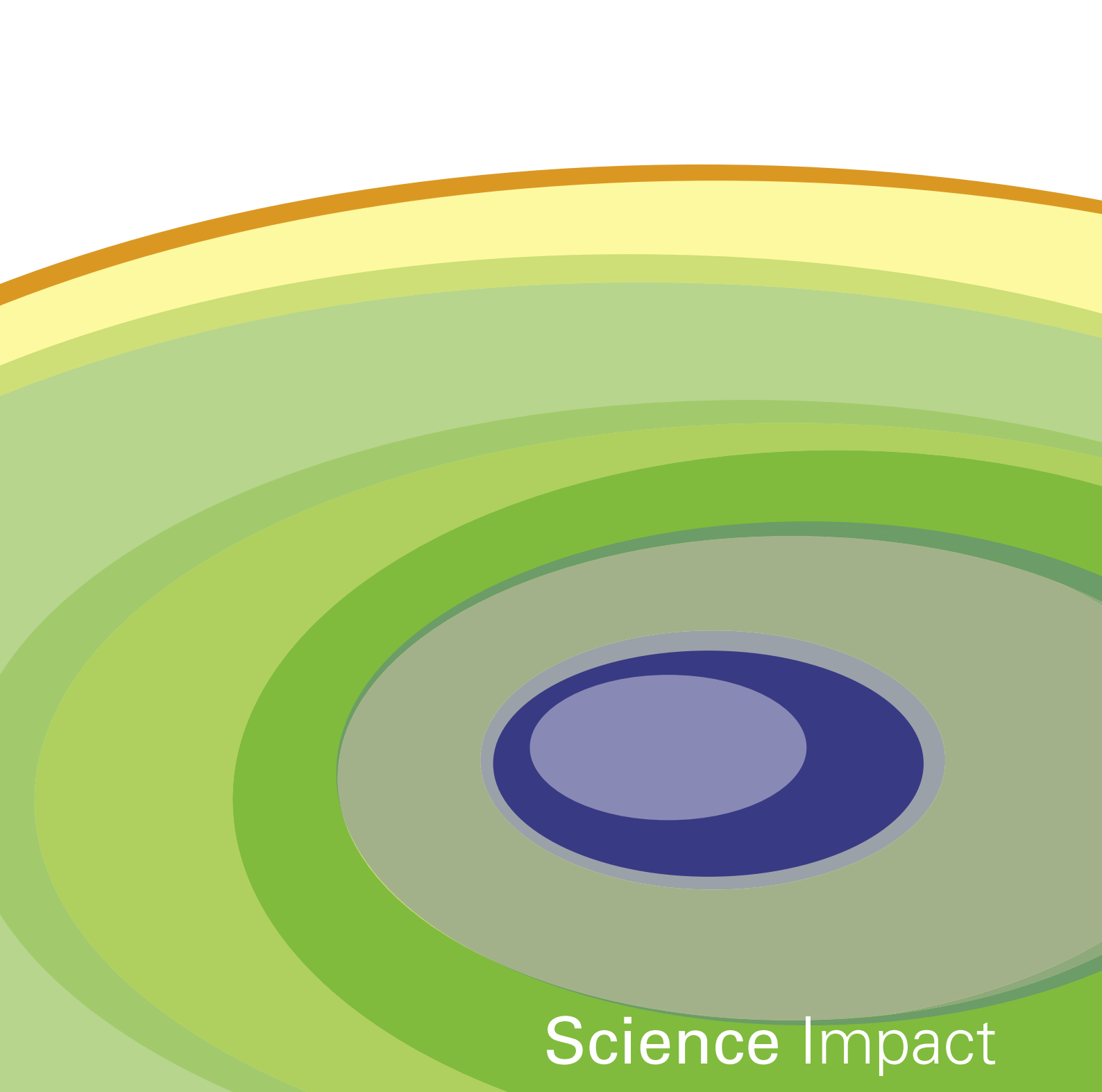
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Open partnership in public-private R&D

Chris Mombers (1951) is deputy director of the Technology Foundation (STW), the Netherlands. He was educated as a biochemist at Utrecht University and did his PhD on the subject of protein – lipid interaction in the red blood cell membrane. For a few years after his PhD he was a policy advisor with the Advisory Council for Science Policy in The Hague and worked on several public reports regarding science and technology indicators, bibliometry and patent statistics. From 1984 onwards he has worked for the Technology Foundation (STW) in several positions. He was co-founder of several public-private research programs in toxicology, biomarkers, crop protection, food and nutrition, nanotechnology and valorisation.

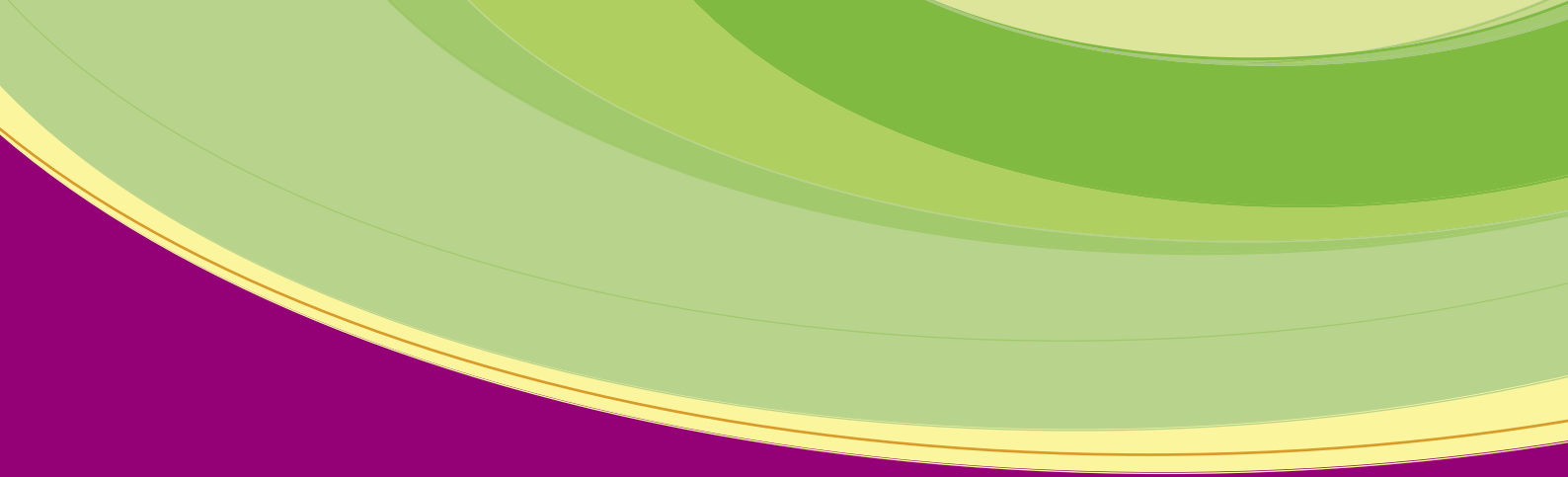
Fundamental research is a basic source for the creation of new options for innovation. However, universities, being important producers of fundamental knowledge, do not have innovation as their first mission, and private companies, the primary drivers for innovation, are often not able to do fundamental research themselves. Therefore knowledge transfer from public research organizations to private enterprise (especially small and medium enterprise) is of vital importance as a first step towards science driven innovation. There is no general prescription for an effective public-private knowledge transfer in all cases, although lessons can be learned from successful examples. Foremost, active knowledge transfer is a matter of character, culture and attitude vested in academic researchers that should be encouraged and facilitated. Secondly, a few principles contribute to an effective, and lasting, interaction between scientists and the external users of research results.

The Technology Foundation STW is a national funding organisation for basic research in Dutch universities. In the selection of research proposals potential utility of the expected results is an important criterium and, in granted projects, users are involved right from the start. Granted projects are managed by STW in order to optimize technology and IP-transfer. For about twenty years now STW keeps record of the outcome of projects in the Open Technology Program. In this paper, from a practical point of view, some observations will be presented about the effectiveness of knowledge transfer policy.

A graphic consisting of several concentric, horizontally-oriented ovals. The innermost oval is a dark blue/purple color. Surrounding it is a light grey oval, followed by a green oval, then a light green oval, and finally a yellow oval at the top. The bottom of the graphic fades into a solid purple background.

Science Impact

SESSION C
Scope, Limits and Role of Impact Evaluation



Participants

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Ben Martin, University of Sussex, UK
Benoit Godin, INRS (Montreal), CA
Wolfgang Polt, Joanneum Research, AT



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Introduction

In a recent commentary in “Nature” on the potential benefits of careful citation analysis, the authors wrote: “Institutions have a misguided sense of fairness of decisions reached by algorithm; unable to measure what they want to maximize (quality), they will maximize what they can measure”

In my introduction I want to pursue the theme of the kind of dilemma that institutions – and the individuals who work in and with them – find themselves in, by broadening the context. The drive towards more transparency and accountability is by no means confined to the academic world. What has contributed to what Benoit Godin calls the “Culture of Numbers” and what are some of the consequences of a managerial culture that claims that ‘only what can be measured, can be managed’? Moreover, impact evaluation must distinguish between impacts on the research community and impacts on other stakeholder groups. Empirical studies show that that this may give rise to contradictory results and that careful trade-offs must be considered if successful impact evaluations are to be carried out. But the main thrust of my question can also be put differently: *What does transparency conceal?*

Helga Nowotny, Professor em. of Social Studies of Science at ETH Zurich, and former Director of its Collegium Helveticum, is Vice-President of the European Research Council and Fellow, Vienna Center for Urban Knowledge Management, A. She was Chair of EURAB, the European Research Advisory Board of the European Commission from 2001-2006, a function she relinquished upon becoming a member of the Scientific Council of the ERC. She is also Chair of the Scientific Advisory Board of the University of Vienna and member of the Governing Board of the Science Center in Berlin and continues to hold other advisory positions. She has a doctorate in law from the University of Vienna and a Ph.D. in sociology from Columbia University, New York. Before moving to ETH Zurich she was professor at the University of Vienna and Permanent Fellow at Collegium Budapest/Institute of Advanced Study. She has held teaching and research positions at King’s College, Cambridge, the University of Bielefeld, the Wissenschaftszentrum Berlin and at the Ecoles des Hautes Etudes en Sciences Sociales in Paris. She has been a Fellow at the Wissenschaftskolleg zu Berlin and is a former president of the International Society for the Study of Time. She is a member of the Academia Europaea and founding member of Euroscience. In 2003 she received the John Desmond Bernal Prize for life-long achievement in social studies of science and in 2002 the Arthur Burckhardt-Preis. Her main scientific interests are in social studies of science, science and society and social time.

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- After the Breakthrough: the emergence of high temperature superconductivity as a research field (with U. Felt) (1997). Cambridge University Press
- Eigenzeit. Entstehung und Strukturierung eines Zeitgefühls, Frankfurt a.M.: Suhrkamp, 1987
- More than 30 books and 200 articles in scientific journals.



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Assessing The Impact of Basic Research on Society and the Economy

Professor Ben Martin was Director of SPRU (Science and Technology Policy Research) at the University of Sussex from 1997 to 2004. He has carried out research for over 25 years in the field of science policy. In the earliest work with John Irvine, he helped to establish techniques for the evaluation of scientific laboratories and of research programmes. A second area in which he has made an impact is empirical comparisons of national scientific performance and in particular work on the relative decline of British science. A third contribution was to produce the first truly comparable international statistics on government funding of academic and related research. The fourth area of activity has been the collaborative work with John Irvine which pioneered the notion of 'foresight' as a tool for looking into the longer-term future of science and technology with the aim of identifying areas of strategic research and emerging generic technologies likely to yield the greatest economic or social benefits. He was a member of the Steering Group for the UK Foresight Programme from 1993 to 2000. He led the SPRU team that produced the influential review for HM Treasury on the benefits from government funding of basic research. More recently, he has carried out research on the changing nature and role of the university, and on the impact of the Research Assessment Exercise (RAE). In 2004-05, he served as Deputy Chair of the EU High-Level Expert Group advising the European Commission on the potential benefits of establishing a European Research Council.

How can one assess the economic and social impact of basic research? This is an important question as society becomes increasingly dependent on the creation and exploitation of knowledge to yield innovations that generate economic and social benefits. This paper will first look at the conceptual and methodological reasons why there is no simple answer to the question, 'What are the economic and social benefits of basic research?' Indeed, efforts to obtain a quantitative answer to this question may ultimately prove more misleading than helpful. The paper will then review the literature, showing that there is now an extensive body of studies on the economic and social benefits of publicly funded basic research. The results show that the benefits are very substantial, certainly sufficient to justify considerable government investment in basic research. They also show that the benefits come in various forms. One can classify these benefits into seven main mechanisms or 'exploitation channels' through which the benefits of basic research may flow to the economy or to society more generally. An analysis of the evidence on the nature and extent of the benefits associated with each type of exploitation channel reveals that the relative importance of each channel varies with scientific field, technology and industrial sector.

Ben Martin has published seven books, eight monographs and official government reports, and approximately 50 journal articles, and produced 170 other reports and papers. He is an Editor of Research Policy, a former member of the Technical Opportunities Panel (TOP) of EPSRC, and the 1997 winner of the Derek de Solla Price Medal for Science Studies.

Books: S. Hemlin, C.M. Allwood and B.R. Martin (eds.), 2004, *Creative Knowledge Environments: Micro and Macro Studies of R&D and Higher Education*, Aldershot and Brookfield, Vermont: Edward Elgar; (ed. + P. Nightingale), *The Political Economy of Science, Technology and Innovation*, Aldershot and Brookfield, Vermont: Edward Elgar (2000); (ed. + R. Barré, M. Gibbons, J. Maddox, and P. Papon), *Science in Tomorrow's Europe*, Paris: Economica International (1997); (ed. + J. Irvine, D. Griffiths and R. Gathier), *Equipping Science for the 21st Century*, Aldershot and Brookfield, Vermont: Edward Elgar (1997);

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History as a Source for Measuring the Current Impact of Basic Research on Society

The measurement of science is over one hundred years old. Since 1906, researchers and statistical bureaus have developed statistics and indicators, first on input, then on output, then on the links between the two. What has proved more difficult is measuring the outcomes or impacts of (basic) research on society and on the economy. Or has it? This paper looks back through history, and documents the very first measurements of impacts in the 1920s and subsequently. These efforts were undertaken by sociologists who were concerned with what was then called the “cultural lag”, or the adjustment of society or culture to technology. Many, if not most, of the concepts used in measurements of science today (exponential growth, diffusion, gaps, etc.) arose from this earlier work. However, what has been lost from these efforts is the scope of the thinking as well as the many dimensions of science that were measured at the time (social, cultural, environment, health, economy, etc.).

Based on this history, the author suggests a precise method for measuring the impacts of basic research on society and on the economy. It is, again, in history (1960s) that the author has found this method. The author concludes that measuring impacts is without doubt feasible, but that the method is quite different from measuring input and output and, above all, is scarcely amenable to national summation. The key to the success of such an undertaking is 1) a precise definition of what an impact is, 2) a theory on the mechanisms by which science translates into impacts, and 3) a typology of impacts covering many dimensions.

Benoit Godin is professor at INRS, Université du Québec (Montreal, Canada). He holds a DPhil in science policy from Sussex University (UK). He has written extensively on science policy and statistics. He is founder of the Canadian Observatoire des sciences et des technologies (OST), and director of the Canadian Science and Innovation Indicators Consortium (CSIIC). He is currently involved in a project on the history of science and technology statistics from which two books have recently been published, and over 30 articles produced: *Measurement and Statistics on S&T: 1920 to the Present*, London: Routledge, 2005, and *La science sous observation: cent ans de mesures sur les scientifiques, 1906-2006*, Québec: Presses de l'Université Laval, 2005.

Books: Godin, B., *La science sous observation: cent ans de mesure sur les scientifiques, 1906-2006*, Québec : Presses de l'université Laval, 2005. [Mention « Livre choisi », revue *Commentaires* (fondée par Raymond Aron), automne 2006] Godin, B., *Measurement and Statistics on Science and Technology: 1920 to the present*, Series in the History of Science, Technology and Medicine, London: Routledge, 2005. (Translated into Chinese in 2007; Institute of Scientific and Technical Information of China; 3 000 copies)

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Wolfgang Polt



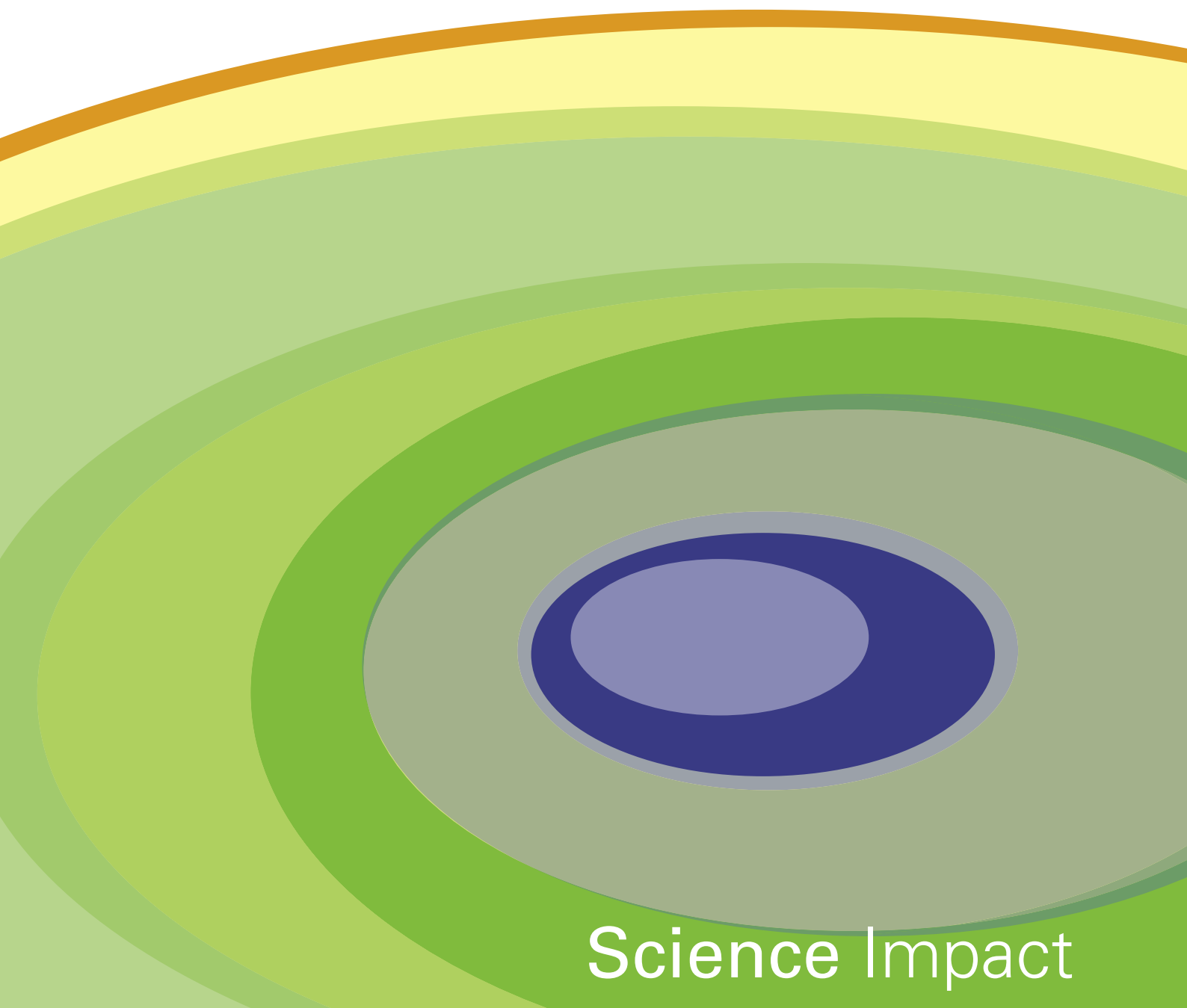
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Head of the Viennese Office of Joanneum Research, Institute for Technology and Regional Policy. He graduated in Economics at the University of Vienna and worked at research institutions in Austria, Finland and at the OECD in France. Currently lecturer at the University of Business and Economics in Vienna. Throughout his professional career he dealt with the questions of economic and societal impacts of research and technological development and with the design and evaluation of research, technology and innovation policies. In these areas, he worked in projects in various European and Asian countries and for international organisations (EU, OECD). Member of the editorial board of the Journal for Technology Transfer and founding member of the Austrian Platform for Research and Technology Evaluation.

Evaluating the Economic Impact of Basic Research

The challenge to identify the economic impacts of basic research has been addressed by generations of researchers - with considerably variation in results. Nevertheless, applying a great variety of methods, a number of findings have become quite robust over time, e.g. that basic research can create substantial spill-over effects and externalities with economic impact - but that these effects are different between areas and can only be captured by complementary investment in 'adoption capabilities'. Also, our ability to identify these effects on different levels (macro, meso, micro) and from different perspective in time (ex ante, ex post) is not equally well developed. Therefore, current knowledge on economic impacts can only be a poor guide e.g. in the ex ante appraisal of individual projects in basic research or the prioritisation of research fields. It will be argued that for these purposes, other characteristics and potential impacts of research (type and quality of research, societal impacts etc.) are more important selection criteria.

The contribution will try to take stock of recent research in this field, describe the scope and limits of this research and try to formulate lessons for research and innovation policy as well as to outline possible directions for future research.



Science Impact

**CONFERENCE SUMMARY &
CLOSING EVENT**



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Stefan Kuhlmann is a full professor in Foundations of Science, Technology and Society in the Department of Science, Technology, Health & Policy Studies, University of Twente, The Netherlands. Until summer 2006 he was director of the Fraunhofer Institute for Systems Innovation Research (ISI), Germany, and Professor of Innovation Policy Analysis at the Copernicus Institute, University of Utrecht.

Kuhlmann is a political scientist and also studied history. Since 1979 – with changing entrance points and perspectives – he has been involved in studies of technological innovation as a social process. During the last two decades he has analyzed science, research and innovation systems and policies, focusing on the dynamics of governance.

Kuhlmann is co-editor of *Research Policy* (a leading journal in the field), an associate editor of the *International Journal of Foresight and Innovation Policy* (IJFIP), on the Editorial Advisory Board of *Evaluation*, *The International Journal of Theory, Research and Practice*, and a co-editor of “*Forschung - Politik - Strategie - Management*”.

Stefan Kuhlmann is a member of a number of professional and academic associations, including the Executive Committee European Network of Excellence PRIME; the Netherlands Graduate School of Science, Technology and Modern Culture (WTMC); the European Commission's High Level Expert Group on “Maximising the wider benefits of competitive basic research funding at European level” (Directorate General Research); the EC's Expert Group on the Follow-up of the Research Aspects of the Lisbon Strategy; the Evaluation Board of the Alexander von Humboldt Foundation; the Commission for the Evaluation of the “Commissie Overleg Sectorraden (COS)” (Sector Councils), on behalf of the Dutch Minister of Education, Culture and Science (OCW), 2005; the steering committee of the Six Countries Programme -The International Innovation Network (1994-2006).

The Impact of Basic Research – Truisms, Insights, and Conclusions

When discussing the role of basic research in society and economy one will inevitably be confronted with two apparently antithetic truisms: (1) Since science, though based on methodological systematics, is in the first place a creative enterprise, often fed by serendipity, its processes and its impact on society and economy are elusive and hardly to control. Pushing for effective impact would undermine the very working of science. (2) Without requests from society/government and economy from science and without their investments in science there was no science – hence there is good reason to expect and control for useful and effective science impact.

Is there any way out of this gap? What are appropriate and realistic expectations vis-à-vis the non-scientific impact of science? What is this impact about? Are there ways to facilitate useful and effective impact without stalling scientific creativity and productivity? The conference made an attempt to explore the reciprocal interactions between basic research, society and the economy. The contributions examined methods for evaluating and reinforcing the impact of basic research, addressing these topics from a theoretical and historical viewpoint. This was done in three steps. First, the theoretical background was explored, combined with a historical overview of the evolution of the science, society and economy interaction. In a second step the implications, societal, scientific and economic, were addressed. In addition, the political implications for the practice of basic research and its funding were described. The final step presented scientific opinions and practical examples of science impact evaluation.

This final intervention will summarize the conference debates and offer an outlook.

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The Beauty of Basic Research: Computers Explore Musical Expressivity

What makes music come alive? How do musicians express structure and emotion in a performance? What is it that makes famous concert artists so unique and unmistakable?

Questions such as these serve as points of departure for a journey of discovery into the world of expressive music performance. It will be shown how computers (of all things) are beginning to give us new insights into such elusive phenomena as musical expression and artistic musical style. Behind this is basic inter-disciplinary research in computer science, artificial intelligence, and musicology. New computer methods are explored that enable us to literally see aspects of musical expressivity, to quantify stylistic differences between great artists, and even to interact with, and shape, expressive music performances.

An integral part of the presentation will be a recital of Wolfgang Amadeus Mozart's Piano Sonata KV 280 in F major by the young Viennese (Korean) pianist **Erika Chun**, on the new computer-monitored concert grand piano CEUS by Boesendorfer, Vienna.

Gerhard Widmer is professor and head of the Department of Computational Perception at the Johannes Kepler University Linz, Austria, and head of the Intelligent Music Processing and Machine Learning Group at the Austrian Research Institute for Artificial Intelligence in Vienna.

He holds M.Sc. and Ph.D. degrees in computer science from the University of Technology Vienna, and an M.Sc. from the University of Wisconsin/Madison, USA.

He has been active both in "mainstream" Artificial Intelligence and machine learning research and in the field that has come to be called "AI and Music" (of which he arguably is one of the pioneers). His research interests include machine learning and intelligent signal and data analysis, and their use in studying and modelling musical behaviours and analysing musical data. With his research groups in Linz and Vienna, he also conducts application-oriented research on Music Information Retrieval and novel music interfaces.

In 1998, he was the recipient of one of Austria's most highly funded research awards (the 'START Prize') for his work on Artificial Intelligence and expressive music performance. He also won a national piano competition at age 13, but soon afterwards decided that classical music was horrible, and quit music school. More information about him can be found at <http://www.cp.jku.at/people/widmer>.

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IMPRESSUM

Fonds zur Förderung der wissenschaftlichen Forschung (FWF),
Sensengasse 1, 1090 Wien, Austria, Tel.: +43-1-505 67 40-0, Fax: +43-1-505 67 39,
office@fwf.ac.at, www.fwf.ac.at, **President** Christoph Kratky,
General Manager Gerhard Kratky, **Editorial Office** Alexander Damianisch,
Design and Production Starmühler Agentur & Verlag, **Print** Radinger Print,
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