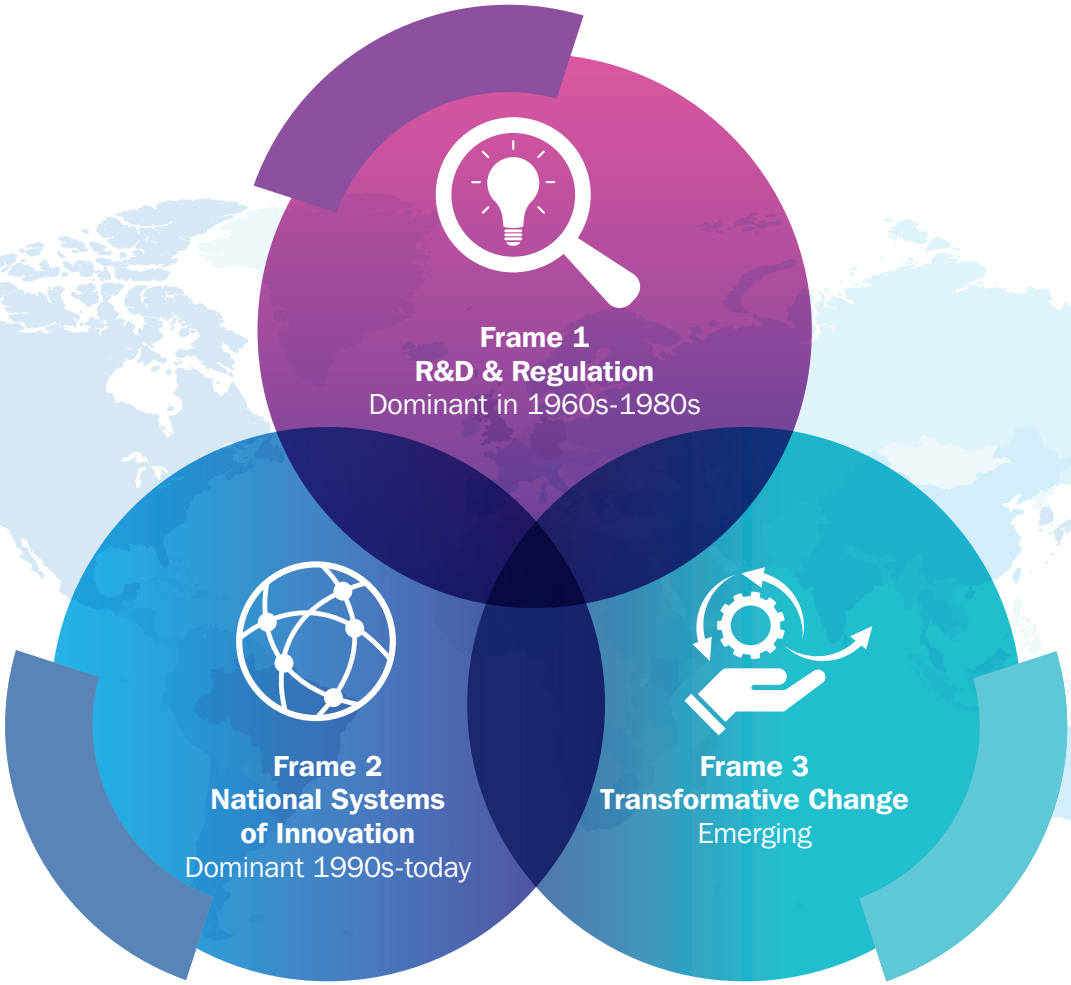
TRAINING COURSE READER



Three Frames of Innovation Policy

R&D, NATIONAL SYSTEMS OF INNOVATION, TRANSFORMATIVE CHANGE

18th–22nd April 2016 Bogotá, Colombia

Commissioned by Colciencias

UNIVERSITY OF SUSSEX | SPRU CELEBRATING 50 YEARS

Contents

Introduction

Welcome to your training course – Three Frames of Innovation Policy – R&D, National Systems of Innovation, Transformative Change delivered by the Science Policy Research Unit (SPRU) at the University of Sussex, as part of the co-operation agreement between SPRU, and Colciencias (Government of Colombia's Department of Science, Technology and Innovation). The co-operation aims to strengthen Colciencias's science, technology and innovation policy design and evaluation unit. It outlines areas of collaboration, training, mentoring and mutual learning and provides exciting opportunities for joint working both on new research projects and the development of innovation policy.

Alejandro Olaya Davila, Deputy Director of Colciencias said: "We recognize that SPRU is the leader in the world for science policy. In Colombia right now we are developing a new national science and innovation policy. We want to do this with the best organisation in the world to help improve our system in Colombia". SPRU has an outstanding track record working with partners across the globe, combining world leading academic research and practical policies. It has long-standing expertise on Latin America, and the agreement deepens its relationship with Colciencias, the main actor in Colombia on science, technology and innovation policy.

Professor Johan Schot, Director of SPRU said; "The world is currently in a period of deep transition, requiring structural changes to deal with the big challenges of today. At SPRU we are working on ideas for the next generation of innovation policies, focused on promoting sustainable and inclusive innovation. We are delighted to be working with Colciencias, and hope this agreement paves the way for a long-term relationship that will see us develop our ideas together."

During this course participants will not only learn about the three frames for innovation policy – research and development (R&D), National Systems of Innovation and Transformative Change/Innovation, they will start to apply these to specific innovation policy initiatives in Colombia. Key concepts and tools including the multi-level perspective and strategic niche management will be un-packed to allow a deeper understanding of the nature of transformative change, the importance of experimentation and an opportunity to re-think the aims of innovation policy in direct relation to specific societal challenges.

Having built up a strong base on the three framings participants will learn about this in relation to two specific types of innovation that are important in the national context – Grassroots Innovation and Inclusive Innovation. Through a combination of lectures and group exercises we identify examples in Colombia and apply the frameworks and tools. Finally, the importance of evaluation in the context of the three framings of innovation will be explored, highlighting the importance of using different evaluation tools for specific roles within the policy process.

The expert team at SPRU that have developed this course have really enjoyed putting it together and are looking forward to a very productive week, working with all participants to share and discuss new ideas on developing innovation policy for transformative change. We hope you enjoy it as well, and welcome your participation and feedback throughout the week and beyond.

Learning objectives

THREE FRAMINGS OF INNOVATION

- Understand characteristics of three frames for innovation policy
- Ability to apply three frames to innovation policy initiatives in Colombia
- Understand how the three frames complement and question each other

EXPLAINING TRANSFORMATIVE CHANGE USING THE MULTI-LEVEL PERSPECTIVE

- Understand nature of Transformative Change through lens of Multi Level Perspective
- Understand importance and process of experimentation and opening up for Transformative Change
- Understand concept of Strategic Niche Management as a tool for Innovation Policy for Transformative Change
- Rethink the aims of innovation policy in direct relation to specific societal challenges

GRASSROOTS INNOVATION

- Appreciate examples of grassroots innovation internationally, and be able to identify examples in Colombia
- Be able to apply a niche analytical framework to supporting grassroots innovation
- Understand three different perspectives on grassroots innovation
- Begin to develop policies for grassroots innovation

PRINCIPLE CONCEPTS SURROUNDING "INCLUSIVE INNOVATION"

- Understand the definitions and scope of inclusive innovation through the 3 frames
- Apply social network analysis as a diagnostic tool to evaluate for inclusive innovation
- Recognize the role of intermediary organisations in the implementation of inclusive innovation
- Apply and reflect upon STI for inclusive innovation through exercises and presentations

EVALUATION: CONCEPTS, ROLES AND ITS RELATION TO THE THREE FRAMINGS OF INNOVATION

- Recognize the different ways in which evaluation can be understood, of its roles within the policy process and of how the different roles will call for different evaluation techniques.
- Generate awareness of the constraints that need to be taken into consideration when designing an evaluation strategy and selecting evaluation methods and practices.
- Generate awareness of how specific evaluation techniques imply, often implicitly, a specific understanding of innovation.

Summary programme

TIME	TOPIC	SPEAKER
DAY 1		
9.00-15.45	a. Welcome and introduction b. Lecture: Three Framings of Innovation Policy c. Group work: identify innovation policy initiatives in Colombia which match the three frames d. Lecture: Explaining Transformative Change using the Multi-Level Perspective	Yaneth Giha Johan Schot
15.45-17.00	Exhibition and discussion of photos and gadgets Objective: To understand core objectives and expectations of participants and their views on how do they conceive innovation policy?	Johan Schot
DAY 2		
9.00-17.00	a. Lecture: Innovation Policy for a World in Transition b. Group work and group presentations: main challenges in Colombia and how innovation can contribute to address them c. Lecture: Grassroots innovation d. Group work and group presentations: design policies for a specific aspect of grassroots innovation e. Lecture: Principle concepts surrounding "inclusive innovation"	Adrian Smith Matias Ramirez
DAY 3		
9.00-15.30	a. Lecture: Inclusive Innovation through STI policy frames 1 and 2 b. Group work: Establishing local networks of producers and entrepreneurs, Network structures, weak/dense links, who is at the centre c. Lecture: Frame 3: Innovation policy for transformative change d. Group work: building innovation, systems and transitions in inclusive ways e. Lecture: Intermediation, inclusion and transition	Matias Ramirez
DAY 4		
9.00-16.00	a. An introduction to the concepts and roles of evaluation b. Group work: identify Colombian policy goals, criteria, variables and indicators associated to these goals c. Lecture: Innovation through the three frames and evaluation approaches. Frame 1: Focusing on scientific contributions to knowledge d. Group work and general discussion e. Lecture: Frame 2. Systems of innovation and the focus on interactions a. Group work: Evaluating a technology centre in Colombia	Jordi Molas-Gallart Ismael Rafols
16.00-18.00	Social event to promote SPRU programmes and scholarships	
DAY 5		
8.00-8.45	Breakfast with Alejandro Olaya Davila, Deputy Director of Colciencias, Johan Schot, Director of SPRU, lecturers and all participants	
9.00-15.00	a. SPEED DATING with SPRU b. Lecture: transformations and democratic participation in evaluation c. Group work: applying portfolios evaluation to Colombia's cases d. Wrap up session: more challenging questions or applied cases for further analysis e. Closing remarks by Johan Schot	SPRU team Ismael Rafols Johan Schot

Detailed programme

TIME	LECTURE/TOPIC	SPEAKER
MONDAY 18 APRIL 2016		
9.00-9.30	Welcome & Introductions	Yaneth Giha, Johan Schot
9.30-11.00	**Lecture:** Three Framings of Innovation Policy	Johan Schot
11.00-11.15	**Break**	
11.15-13.00	**Group work: Three framings of innovation** Identify innovation policy initiatives in Colombia which match the three frames	Johan Schot
13.00-14.00	**Lunch**	
14.00-14.45	**Presentation** Results of group work and discussion of results (each group gets 5 minutes)	
14.45-15.30	**Lecture:** Explaining Transformative Change using the Multi-Level Perspective	Johan Schot
15.30-15.45	**Break**	
15.45-17.15	**Activity** Exhibition and discussion of photos and gadgets	All
17.15-17.30	Closure of the day	Johan Schot
TUESDAY 19 APRIL 2016		
9.00-9.15	**Lecture:** Innovation Policy for a World in Transition	Johan Schot
9.15-10.15	**Group work:** What are the critical challenges in Colombia today? How might innovation address these challenges?	Johan Schot
10.15-11.00	Presentation of results of Group work (5 minutes each)	
11.00-11.15	**Break**	
11.15-13.00	**Lecture:** An introduction to grassroots innovation	Adrian Smith
13.00-14.00	**Lunch**	
14.00-15.00	**Group work:** design policies for a specific aspect of grassroots innovation	Adrian Smith
15.00-15.45	Presentation of Group work results	
15.45-16.00	**Break**	
16.00-17.00	**Lecture:** Principle concepts surrounding “inclusive innovation”	Matias Ramirez

TIME	LECTURE/TOPIC	SPEAKER
WEDNESDAY 20 APRIL 2016		
9.00-10.30	**Lecture:** Inclusive Innovation through STI policy frames 1 and 2	Matias Ramirez
10.30-10.45	**Break**	
10.45-11.30	**Group work:** Establishing local networks of producers and entrepreneurs, Network structures, weak/dense links, who is at the centre.	Matias Ramirez
12.15-13.00	**Lecture:** Intermediation, inclusion and transition	Matias Ramirez
13.00-14.00	**Lunch**	
14.00-14.45	**Group work:** Building innovation, systems and transitions in inclusive ways	Matias Ramirez
14.45-15.30	Presentation of Group work results	Matias Ramirez
15.45-16.00	Closure of the day	
THURSDAY 21 APRIL 2016		
9.00-11.00	**Lecture:** An introduction to the concepts and roles of evaluation	Jordi Molas-Gallart
11.00-11.15	**Break**	
11.15-12.00	**Group work:** identify Colombian policy goals, criteria, variables and indicators associated to these goals	Jordi Molas-Gallart
12.00-13.00	**Lecture:** Innovation frames and evaluation approaches Frame 1. Focusing on scientific contributions to knowledge	
13.00-14.00	**Lunch**	
14.00-14.30	**Group work:** Are the principles of the Leiden manifesto appropriate to Colombia?	Ismael Rafols
14.30-15.15	**Presentation of group work results and general discussion**	Ismael Rafols
15.15-16.00	**Lecture:** Frame 2. Systems of innovation and the focus on interactions	
16.00-16.15	**Break**	
16.15-17.00	**Group work:** Evaluating a technology centre in Colombia	Jordi Molas-Gallart
FRIDAY 22 APRIL 2016		
8.00-8.45	**Breakfast with all participants:** Deputy Director of Colciencias, Johan Schot and lecturers, participants.	
9.00-10.30	**Speed Dating with SPRU**	
10.30-10.45	**Break**	
10.45-12.15	**Lecture:** Frame 3: Transformations and democratic participation in evaluation	Jordi Molas-Gallart
12.15-13.00	**Group work:** Applying portfolio evaluation to a technology centre	Ismael Rafols
13.00-14.00	**Lunch**	
14.00-15.00	**Wrap up session:** more challenging questions or applied cases for further analysis	Johan Schot
15.00-15.15	Closing remarks from Johan Schot	

Three Frames of Innovation Policy

Market Failures, System Failures, Social Needs and Environmental Failures

A Working Paper by Prof. Johan Schot and Prof. Ed Steinmueller, April 2016

1. RATIONALE/JUSTIFICATION FOR POLICY INTERVENTION & BROADER NARRATIVE AROUND IT

MARKET FAILURE

Knowledge production leads to innovation defined as commercialised invention which leads to economic growth (driven by productivity growth).

However, market actors are not willing and able to produce the socially desired levels of scientific knowledge. Stress on public welfare nature of knowledge production.

During the 1980s the added argument was that government intervention was necessary to preserve national competitive advantage. It was called intervention in pre-competitive research (also to preserve notion of level playing field for international competition.

Markets also produce so called externalities (for example environmental impacts, and unemployment) which needs therefore government regulation.

Strong belief that market plus appropriate investment in science and technology can solve environmental and social problems in the long run while acknowledging existence of short term problems.

SYSTEM FAILURE

Knowledge production does not automatically lead to innovation. Economies need to have capabilities to exploit, import, improve and transfer & firms and sectors absorptive capacity for similar purposes.

Knowledge is sticky, and tacit and informal characteristics are crucial and therefore learning by doing, using and interaction & closeness (clusters).

Sectors are different in terms of knowledge production, transfer and use. Some sectors produce innovations through R&D while other work with specialized suppliers for example.

The capabilities are embedded in systems of innovation. These can be sectorial, regional and national systems of innovation.

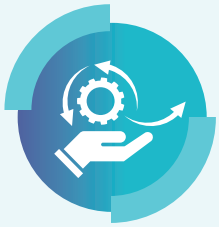
These systems and learning effects generate economic growth and build national competiveness, not investment in R&D.

Systems of innovation refers to linkages between firms (user-producer relationships), between firms and knowledge production institutions such as universities and between firms, knowledge production institutions and government. The latter linkages are important to prevent misalignment between government policies and knowledge production and exchange.

The other crucial capability aspect is entrepreneurship. They are needed to bring products and processes to the market and open up new markets.

The notion of externalities is also part of this frame and social and environmental problems need to be managed through regulation.

Strong belief that science and technology can solve problems, but more critical approach to idea of market. Markets are conceptualized as institutions which need to be constructed by institutions and entrepreneurs, and might not always provide desired outcomes. Focus on importance of non-market institutions (for example standards, but also networks and platforms which provide better coordination).



SOCIAL AND ENVIRONMENTAL NEEDS FAILURE

Knowledge production does not automatically lead to desired outcomes in terms of the sustainable development goals (or any other expression of social needs). There is a gap between social needs and knowledge production and innovation. This gap is generated in the knowledge production and innovation itself, if these processes are left to themselves. Then innovation produces inequality, environmental damage (such as climate change) and unemployment. We therefore need to make a distinction between bad and good innovation.

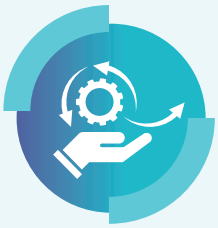
The main rationale for policy is to direct innovation into desirable directions and block undesirable directions. Or in other words to horizontally integrate and co-ordinate environmental, social and science and technology policies.

In this frame it is still argued that science and technology can produce welfare, but not automatically, and socio-technical systems built in the past have become part of the problem and can no longer solve contemporary pressing problems. They need to be replaced by new socio-technical systems which address social and environmental needs. This replacement is called transition or transformation, and hence innovation policy should focus on transformative change or enabling transitions.

2. COUNTER (ALTERNATIVE) NARRATIVE

Appropriate Technology Development. Focus on small-scale solutions.

Politics of Science and Technology; Democratization of Science and Technology; open up trajectories to societal influence of marginalized actors; Constructive Technology Assessment, Interactive Technology Assessment.



Strong State intervention with massive investment in Big Technologies which promise to solve problems, Ecomodernism is one expression of this rationale

&/or

Social Innovation; move away from technical solutions, they are part of the problem.

3. FOCUS

Knowledge Production, R&D Breakthrough or Radical Innovation.

Product and Process Innovation Importance of both radical (and revolutionary) and incremental innovation. Introduction of idea of path-dependency (and lock-in), e.g. not all options are considered in an equal way; knowledge production is biased and focused in a certain direction, and thus re-direction is a possible focus, and disruption a desired outcome.

Socio-technical System Change (or architectural innovation). These systems are driven by socio-technical regimes (routines) or vested interests. Alignment between various system elements and in particular between the social and technical is crucial. Emphasis is on alignment techno-economic paradigm formation. Opening up innovation to discussion about directionality; transition to new socio-technical systems, which includes social innovation & inclusive innovation.

4. INNOVATIVE ACTORS

Market Actors with a tendency to focus on large firms since they generate R&D; however contribution of smaller very innovative firms also recognized.

Market actors, more explicitly including SMEs, entrepreneurs, collective invention and innovation, and industry associations. Contribution of other actors such as universities and various government agencies. More focus on firms as users. Introduction of idea of lead user. Firms and organisations with capability and resource to innovate.

All actors in the economy and society can be innovative, including consumers, marginalized people, and civil society. Involvement of the latter groups is important for redirecting technical change in more sustainable directions.

5. TYPICAL POLICY ACTIVITIES

R&D stimulation in various forms (subsidies, tax credits, procurement, mission-oriented programmes) and establishing a healthy business climate which stimulates investment in R&D. Both developed and developing countries need to invest in R&D. Emergence of 3% norm and ambition in EU.

Building IPR regime providing appropriate mix of protection and option for diffusion and larger spread of benefits

Education policy, with emphasis on Science, Technology, Engineering and Math (STEM subjects).

Science Communication to explain important of STEM to wider public, needed to legitimize larger investment funded through taxation.

Foresight to select focus areas.

Regulation and technology assessment to manage negative impacts. Technology assessment efforts mainly focus on informing parliaments and wider public debate.

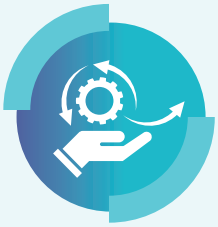
Regulation efforts lead to debates about best policy mixes of economic, command and control and social and informational instruments in case of environmental impacts. in the case of the social policies debate it is about levels of benefits, policies for reskilling etc.

Regulation is not integrated in Science and Technology Policy.

Constructing links between the actors (building platforms, networks, databases) and organizing technology transfer; stimulate learning by doing, using and interacting, stimulate Entrepreneurship; incubators.

In general focus on capability development, enhancing absorptive capacity, ability of State to stimulate development and deliver positive contributions to innovation and help direct innovation.

For example, there is a stronger belief in importance of building government programmes which stimulate development of cleaner technologies instead of end-of-pipe technologies. The latter are add-on solutions that simply capture a pollutant while not solving the problem at source. Cleaner technologies seek to prevent pollution at source.



Stimulate opening up, debate between promotion of various options, generation of more options and diversity, for example through experimentation (niche construction) & open innovation; organize and stimulate destabilization of dominant societal-technical systems and regimes; stimulate institutional entrepreneurship & work of intermediaries; organize closing down of less desirable directions; organize participatory anticipation; exploring new modes of governance; introduce responsible research and innovation & constructive technology assessment; building interface competences between the social and the technical, for example through higher education policy which should aim for bridging the gap between the STEM domain and the social sciences and humanities.

6. INNOVATION MODEL

Linear model: Invention (Discovery), Innovation (Commercialisation) and Diffusion (Spreading).

Neo-classical economics models which stress importance of market failure.

Chain-Linked Model.

Evolutionary economics models which stress importance of variation selection, and retention (and path-dependency)

Hidden Innovation.

STS understanding of innovation, quasi-evolutionary model, sustainability transitions & transformation models.

7. FRAMEWORK CONDITIONS

Strong state; Social optimism concerning social value of science and technology.

Strong State plus Trust and Social Capital.

Reflexive governance & Ability to navigate political conflict between many societal groups; reform of democracy; reconceptualization of science and technology (accept it is not a neutral tool).

Appendix

Application of three frames to Evaluation and Inclusive Innovation Issues, as introduced by Jordi Mollas-Gallart and Ismael Rafols (evaluation) and Matias Ramirez (inclusion)

EVALUATION

Focus on input and output indicators: R&D expenditures, patents, publications.	Focus on network links and processes leading to learning and generation of impact.	Inclusive discussion of policy objectives and evaluation criteria, consideration of the directionality of innovations, space for variety, alternatives.

INCLUSION

Linear and planned, fragmentation, paternal, participative.	Learning, connectedness, institutions, System dynamics.	Social entrepreneurs, community, opening up; Bottom-up, different directions are legitimised.

Recommended readings

Listed here are recommended background readings to provide participants with a broader and deeper understanding of the content shared during the course and to reflect on following the lectures. For the full texts please see the Appendix.

THREE FRAMES OF INNOVATION AND TRANSFORMATIVE CHANGE

- Kline, S. & Rosenberg, N. (1986) "An overview of innovation", in: R. Landau and N. Rosenberg (eds.), The Positive Sum Strategy. Harnessing Technology for Economic Growth, Washington D.C.: National Academy Press, pp. 275-305
- Cozzens, S. & Sutz, J. (2012) "Innovation in informal setting: a research agenda". Innovation and Development, vol 4, no. 1, pp. 1-31
- Schot, J, Geels, FW. (2008) Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Technology Analysis and Strategic Management, vol 20, no. 5, pp. 537-554

GRASROOTS INNOVATION

- Seyfang, G. and Smith, A. (2007) 'Grassroots Innovations for Sustainable Development: Towards a new research and policy agenda' in Environmental Politics 16(4) pp. 584-683
- Smith, A., Hargreaves, T., Hielscher, S., Martiskainen, M., & Seyfang, G. (2015). Making the most of community energies: Three perspectives on grassroots innovation. Environment and Planning A
- Smith, A., Fressoli, M., & Thomas, H. (2014). Grassroots innovation movements: challenges and contributions. Journal of Cleaner Production, 63, pp. 114-124

INCLUSION

- Marcel Fafchamps (2006) Development and social capital, The Journal of Development Studies, 42:7, pp. 1180-1198
- Ramirez, Matias and Bernal, Paloma and Clarke, Ian and Hernández Umaña, Iván Darío, Distinguishing Patterns of Learning and Inclusion Through Patterns of Network Formation in Developing Agricultural Clusters. (October 13, 2014). SWPS 2014-20. Available at SSRN: http://ssrn.com/abstract=2743096
- Sutz, J. and Tomasini, C., (2013) "Knowledge, innovation, social inclusion and their elusive articulation: when isolated policies are not enough". In International workshop on new models of innovation for development, University of Manchester (Vol. 4, No. 5). July pp. 1-13

EVALUATION

- Majone, G. (1989). Evaluation and Accountability. Evidence, Argument, and Persuasion in the Policy Process. New Haven and London, Yale University Press: pp. 167-183
- Molas-Gallart, J. (2012). "Research Governance and the Role of Evaluation: a Comparative Study." American Journal of Evaluation 33(4): pp. 577-592
- Hicks, D., P. Wouters, L. Waltman, S. de Rijcke and I. Rafols (2015). "The Leiden Manifesto for research metrics." Nature 520: pp. 429-431
- Spaapen, J. and L. van Drooge (2011). "Productive interactions in the assessment of social impact of research." Research Evaluation 20(3): pp. 211-218
- Ismael Rafols, Tommaso Ciarli, Patrick van Zwanenberg and Andy Stirling (2012) Towards Indicators for 'Opening Up' Science and Technology Policy. Paper presented at the 2012 STI Conference
- Matthew L. Wallace,• Ismael Rafols (2015) "Research Portfolio Analysis in Science Policy: Moving from Financial Returns to Societal Benefits." Available at SSRN: http://ssrn.com/abstract=2500396

List of participants

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- MSc. Business, Macquarie University
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Lecturers

JOHAN SCHOT

- Professor Johan Schot joined the University of Sussex as the Director of SPRU – Science Policy Research Unit - in January 2014.
- Ph.D University of Twente, Enschede, The Netherlands.
- MA: Social History, Erasmus University, Rotterdam, The Netherlands. Cum laude
- MA: History and Policy, Erasmus University, Rotterdam, The Netherlands, Spring 1985 (cum laude)

Johan is a Professor in the History of Technology and Sustainability Transitions Studies. His research is wide ranging and has always focused on integrating social science and historical perspectives for a better understanding of the nature and governance of radical socio-technical change. Prior to coming to Sussex, he held academic posts at the Eindhoven University of Technology and University of Twente, Netherlands. Under Johan's directorship, SPRU is embarking on an ambitious, new strategy to expand and build on its impressive track record across research, teaching, impact and engagement. The strategy, designed in the lead-up to the 50th anniversary in 2016, draws upon SPRU's extensive activities and captures the best thinking within and beyond SPRU.

Johan is in an excellent position to nurture the development of such a programme in SPRU. His work has always been at the junction of various academic fields and disciplines. In 2009, Johan Schot was elected to the Royal Netherlands Academy of Arts and Sciences (KNAW) for the genuine interdisciplinarity of his work. He has been heavily involved in the development of innovative new concepts and interpretations, and has co-produced highly cited and influential academic contributions. In 2002 he was awarded a VICI grant by the Netherlands Organization for Scientific Research (NWO). This is a personal award for top-scholars comparable with the ERC Advance Investigator Grant. In 2015 he was awarded the Leonardo da Vinci Medal for his outstanding contributions to the history of technology.

His ability to create and pioneer large scale, creative, academic collaborations has helped to transform policy practices, broaden academic understandings, and develop new innovative outputs in the form of programmes, book series and networks. Some examples of these outputs include:

- The Greening of Industry Network,
- The History of Technology in the Netherlands programme,
- The Tensions of Europe Network, which resulted in the Making Europe book series with Palgrave/MacMillan and the European Digital Museum of Science and Technology,
- The Knowledge Network for System Innovation and Transitions to Sustainable Development, and the Routledge Sustainability Transitions Book Series.

Johan has always been keen to support and invest in PhD students and early career scholars. He was the founder and director of several doctoral programmes as well as a string of summer schools and master classes. A passionate teacher, Johan has been involved in designing and developing undergraduate and graduate programmes that incorporate social science and humanities perspectives into the education of future business leaders, policy makers, engineers and scientist.

MATIAS RAMIREZ

- P.hD (2002), Manchester School of Management, University of Manchester Institute of Technology (UMIST) (now University of Manchester)
- B.Sc. Economics, (1997), University College London

Dr Ramirez has undertaken research on inclusive Innovation using Social Network Analysis to analyse incorporation of small producers into innovation processes. Prior to this he has more generally studied social networks to analyse inter-organisational knowledge transfer and capability development in local clusters and system of innovation in developing economy contexts. Recent research includes a study with the Chilean ministry of Agriculture on inclusion of small berry producers in innovation (http://www.redinnovagro.in/docs/matias.pdf) and analysis of intermediary organisations in emerging agricultural clusters in the Peruvian mango and Colombian palm oil sectors..

Other interests include the formation and functioning of communities of practice amongst knowledge workers and scientists. This includes research into the formation of epistemic communities, knowledge management and the relationship between labour mobility and learning. He was the principal investigator in an ESRC funded project looking at networks of knowledge workers in China's largest high technology park between 2006 and 2007.

He also has experience of International comparative analysis of employment regimes and management in high-technology sectors and how networks of professional, occupational and practice-based networks are configured across national systems of innovation.

ADRIAN SMITH

- D.Phil. Science and Technology Policy Studies, The University of Ssussex
- M.Sc. Environmental Technology, Imperial College
- B.Eng. Mechanical Engineering, First Class, Bristol University
- Advanced Diploma Spanish, University of Brighton

Adrian Smith is Professor of Technology and Society. In recent years his research has sought to better understand and support grassroots innovation for sustainable developments. With colleagues he has studied grassroots movements in a variety of sectors and countries. Most recently this has included looking at groups making use of digital fabrication technologies and the spread and development of community-based workshops such as hackerspaces, fablabs and makerspaces.

Most of his research considers the politics and governance of innovation for sustainability. His work draws upon theories and methodologies from political science, innovation studies, and science and technology studies. His research is funded by a variety of academic, government and civil society organisations in the UK and overseas; and it involves empirical studies in both developed and developing country contexts, covering local through national to international scales in a variety of sectors.

He is currently beginning research into grassroots digital fabrication, which falls under a broader body of work on grassroots innovation for sustainability. The main themes of his research over the years are listed below:

- Grassroots innovations for sustainable development
- The transformation of large sociotechnical systems and transitions to sustainability
- Critical policy analysis for sustainability

He also contributes on several blogs such as:

What are we doing when we do open science and inclusive innovation? (posted 12 September 2015 on STEPS Centre site)

Prototyping or debating sustainable developments in makerspaces? (posted 22 September on Sussex Energy Group website)

JORDI MOLAS-GALLART

- Universitat Autònoma de Barcelona
- Licenciado, Economics
- The Johns Hopkins University, Paul H. Nitze School of Advanced International Studies (SAIS)
- M.A, International Relations, Security Studies, University of Sussex, Science Policy Research Unit
- PhD Science Technology and Innovation, SPRU

Jordi Molas-Gallart is Research Professor and Deputy Director at INGENIO, a research institute of the Spanish Council for Scientific Research (CSIC) and the Polytechnic University of Valencia, and Visiting Fellow at SPRU where he obtained his PhD and worked for some 15 years as a researcher and Senior Lecturer.

His research interests include science and technology policy evaluation and impact assessment. He has been a member of several European Commission expert groups, including the group on "Foresight on Key long-term Transformations of European systems: Research, Innovation and Higher Education".

He is President of the European Network of Indicator Designers (ENID), Chair of the Science Europe Working Group on Research Policy and Programme Evaluation and Spanish National Expert in the H2020 Programme Committee for Societal Challenge 6 ('Europe in a changing world – Inclusive, Innovative and Reflective Societies').

He is the author of one book, and more than 80 articles, book chapters, monographs and reports. He is co-editor of *Research Evaluation*, a journal published by Oxford University Press.

ISMAEL RAFOLS

- Universitat de Barcelona, Licenciado in Physics
- Chuo University, Department of Physics, Tokyo, Japan
- MSc Tohoku University, Research Institute of Electrical Communication, Sendai, Japan
- PhD Cornell University, Postdoctoral researcher in nanobiotechnology
- University of Sussex, Science Policy Research Unit, MSc in Science and Technology Policy

Ismael Rafols is a science and technology policy analyst at Ingenio (CSIC-UPV) since 2012, a visiting fellow at SPRU (University of Sussex), where he worked for 8 years, and a research associate at the OST (HCERES, Paris). He works on the assessment of science and technology, studying both how research is evaluated and how evaluations may influence science and technology.

He is interested in opening up new perspectives for visualising diverse scientific contributions, in particular those which tend to be neglected by conventional quantitative assessment. For this purpose, he develops methods to map and measure interdisciplinary research, knowledge exchange and societal contributions of science (the so-called "impact" agenda). In particular, he is working on science visualisations that help interrogate the research landscapes or portfolios of grand challenges such as bird flu or obesity, or the knowledge base of funding agencies and organisations such as universities orpharmaceutical firms.

He serves as Editorial Advisor in the journals *Scientometrics*, *Journal of Informetrics*, *PeerJ Computer Science*, and Journal of Policy and Complex Systems, and participates in the conference committees of science policy conferences such as Atlanta Science Policy, ENID or Eu-SPRI. Dr. Rafols has led projects for the UK Economic and Social Research Council (ESRC, ~€0.5M), US National Science Foundation (with A. Porter, ~$800k), and has been awarded the fellowships Marie Curie (EC, IntraEuropean, 2006-08, and Integration, 2013-2017), Ramón y Cajal (Spain, 2012-2017) and Monbukagakusho (Japan, 1995-2001). He is part of Ingenio's Evaluation and Medical Innovation groups.

Notes

This course was developed and delivered by faculty from the Science Policy Research Unit at the University of Sussex