European Commission

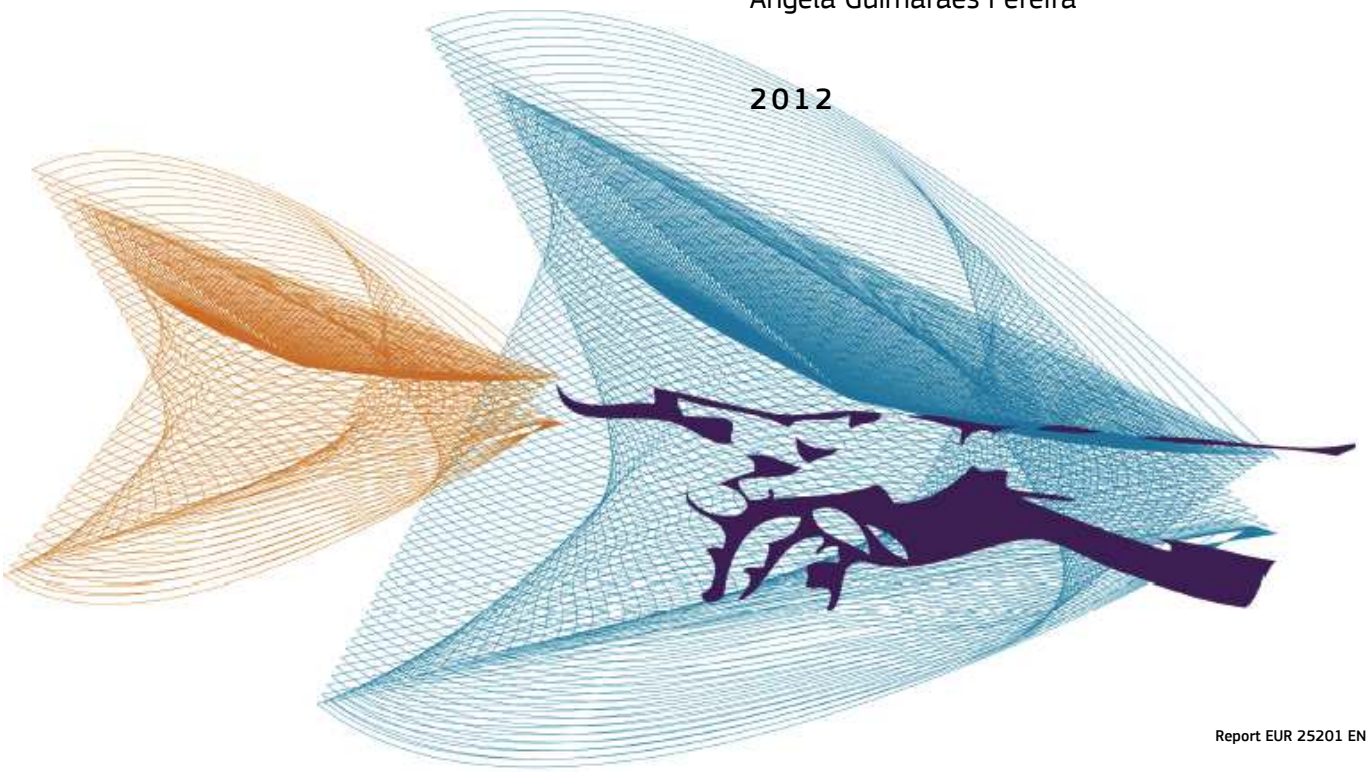
JRC TECHNICAL REPORTS

Science in a Digital Society

Outcomes from a Workshop
Held in Lisbon
18-20 May 2011

Ângela Guimarães Pereira

2012



Report EUR 25201 EN

Joint Research Centre

European Commission
Joint Research Centre
Institute for the Protection and Security of the Citizen

Contact information
Ângela Guimarães Pereira
Address: Joint Research Centre, Via Enrico Fermi 2749, TP 361, 21027 Ispra (VA), Italy
E-mail: angela.pereira@jrc.ec.europa.eu
Tel.: +39 0332 78 5340

https://ec.europa.eu/jrc/en/institutes/ipsc
https://ec.europa.eu/jrc/

This publication is a Technical Report by the Joint Research Centre of the European Commission.

JRC68607

EUR 25201 EN

ISBN 978-92-79-23045-5

ISSN 1831-9424

doi:10.2788/8471

Luxembourg: Publications Office of the European Union, 2012

Printed in Italy

TABLE OF CONTENTS

Background

This workshop is an institutional deliverable of the Action SIDSO (14099) for 2011, and it was co- organised with the Anticipation at JRC Action and The Calouste Gulbenkian Foundation. The workshop explored in an anticipatory mode how current and emergent ICT will affect the conduct of scientific research in the future. Presentations and discussions focused on specific aspects related to emergent methods for engaging society and publics on scientific issues, new approaches for data sharing, mass computing, sharing of analytical tools, evaluating results and disseminating findings. Attention was also paid to impacts and security aspects associated with those approaches, namely related to scientific data and tools access, dissemination and deployment.

The new technologies of digital communication have been changing all areas of social activity; first entertainment and business, and now politics. What will happen to science? In those other areas the trend has been for things to become more fluid, participatory and, to some extent, unstable. Will those trends also affect the conduct of scientific research? Old practices and institutions suddenly face unknown challenges to traditional research methods, hierarchical arrangements, funding lines, peer review processes and reputation management. Quality is redefined. The identification of "grand challenges (or questions)" can now follow different paths and the imbedding of research in society can take many diverse forms. Interactions of science with society are becoming multiform. Hitherto well-codified practices could suddenly become obsolete as previously closed communities of practice are opening up. These trends are for most part technologically driven but they are now stimulated by seemingly irrepressible new social dynamics. How will the conduct of research be affected in the future? How will research results be affected and, overall, is there a risk that those multiform approaches may negatively affect the generation of knowledge?

We have come a long way from the popular image of the Scientist as a lone bespectacled white male in a white lab-coat holding up a test-tube to the light and realising that he has discovered the cure for cancer. Science has become a major social institution, providing support to established institutions and intimately connected to underlying ideologies that hold society together. Along with its great benefits, it produces errors, some of them may lead to harmful situations; as an institution science shares the challenges and pathologies of the societies in which it is embedded. Science was once promising certainty and power on the basis of its value-free discoveries. Today, in this post- normal age, it has to cope with uncertain facts and disputed values in the face of high stakes and urgent policy decisions. The social responsibilities of science and of scientists become ever more challenging in this new digital age.

Science is also changing very rapidly in its practice and self-awareness. While there are still some prestigious and vital 'free' sectors of science, the institution as a whole is now firmly 'industrialised', both its the scale of operation and in the tightness of its relations with commerce and the State. But whereas 'big science' once aimed at controlling of matter and energy, science in the digital age is largely defined by the emerging technologies of information. A deeper imbedding of science in the society is no longer a utopian dream and is, today, naturally unfolding through new forms of learning, sharing, debating, contestation and even healthy exposure enabled by emerging digital technologies. These will create new relations of power, exploitation, consciousness and protest as they affect science.

Finally, it must be noted that this workshop was strongly framed on the ideas of post-normal science which are the ideas that permeate the whole SIDSO activities and projects. The ideas of post-normal science can be summarised as follows: when facts are uncertain, values in dispute, *stakes high* and *decisions urgent* the methodologies needed

to tackle the issues at stake cannot be simply deployments of normal operation of science. This framework introduces "extended peer review" and extended peer communities as the *operationalisation* of a perceived need of scientific enquiry that includes those who have a stake in the policy relevant science.

The abstracts of the talks and roundtables are available at the workshop site: http://sci-ict.jrc.ec.europa.eu.

Objectives of the workshop

In each of the following areas the workshop sought to have insights and discussion about the governance challenges and intriguing elements that could require deeper interrogation.

- Computer Models – ever easier to use and to misuse.
- The 'participatory turn' in science policy, as decision-makers start to share power with citizens.
- ICT as the technology of post-normal science – the new open media of interaction, and how they foster critical and creative thinking and action.
- Citizen science –as participants in projects, as innovators, and as critics, how 'amateurs scientists' are becoming recognized in their own right via contributions to policy and scientific research questions, again made directly possible by ICT technologies
- Science and other areas of knowledge – how the old divisions are melting, as people realise that science cannot maintain claims to objectivity remote from human nature and societal context

Summary of Main Observations

During the 3 days of the workshop, inspiring talks, as well as discussions have tried to debate the main themes of the workshop. In this summary we first account for the salient points arising from the presentations and round tables that interest in general the theme of the workshop: science in a digital society. We then focus on the themes studied at the workshop and last but not least we summarise more thoroughly some of the most relevant "squared tables" held.

Salient points from the debate held in relation to science in a digital society:

1. *Science processes are changing due to ICT*: There is a large body of research / innovation activities taking place in parallel to mainstream research thanks to advances in ICT technologies. The Digital society is fostering profound changes in the conduct of scientific investigations, including integration with *knowledges* other than scientific. Quality of such endeavours becomes an essential element to ensure smooth transitions in knowledge production.

2. *Opportunities for innovation*: ICT offers expanding opportunities for innovation, discoveries, and exchanges in all areas of knowledge production and hence, this is not different for the scientific endeavour. Ignoring the future of science in the digital age will not stop it happening.

4. *New relations of property and governance*: In Open-source software development, creative Commons property and the whole Wiki movement, new relations emerge. In these new industries "mutual aid" turns out to be a profitable corrective to the survival of the "fittest" ideology.

5. *Public participation in policy*: although "participation" by the public in the formation of

policies relating to science is an official desideratum it is still grudgingly granted as a privilege and then tightly controlled in practice. The involvement of amateurs in research, while growing rapidly thanks to the Internet, is still conceived in terms of the use of volunteers for the less demanding tasks. However, this is also changing with a new movement of "publishing" that the digital society is fostering.

6. *Do it yourself knowledge-production movement*: Biopunk [Biopunk: DIY Scientists Hack the Software of Life by Marcus Wholsen. 2011. Published with Current Hardcover], Arduino [See http://www.arduino.cc] and Hackteria [See http://hackteria.org/wiki/index.php/Main_Page] are still new and marginal; but as the relevant technologies become ever cheaper and more powerful, they will grow and synergise in unpredictable ways.

7. *Extended peer reviewing*: Does conventional peer review make sense in a world in which anyone with a cellphone, a WiFi connection and a Twitter account is both reader and reviewer? Internet communities where knowledge is shared, created and evaluated grow by the day. The closed world of journal refereeing is already being diluted. As a community grows that doesn't need traditional journals anymore, the challenge to inherited systems of quality-assurance and governance will be direct.

8. *Security and safety*: as democratisation of science and expertise develops, there will be instabilities and huge risks as "malware" extends from computer software to other research products. Ethical dimensions need to be tackled, inclusive those related to reputation, responsibility and dignity.

9. *Complexity*: Fragmentation of knowledge will follow the large scale capacity to exchange anything and at high speed; but syntheses may be more difficult to provide. Through a novel treatment of complexity, ICT may allow a better and more flexible approach to e.g. sustainability questions, including the recognition that the engagement with the relevant communities is the key element for taming the current and future challenges.

10. *Imagery in science*: The new and constantly evolving image-processing technologies allow manipulating raw scientific data in more and more sophisticated ways. New guiding principles for producing visual evidence, essentially arising from standardized aesthetic concerns, pervade science labs and specialized literature, mixing a variety of expertise, creating new controversial kinds of imagery, bridging epistemic, methodological and normative gaps in unexplored ways. The risk of manipulation is real.

11. *Knowledges integration*: the digital society has, amongst others, made salient once concealed epistemologies; this "disclosure" is becoming pervasive and suggests that emergent models of knowledge politics require inevitably deep integration of different types *knowledges* to address societal issues. No longer solely by pragmatic reasons but because many issues that afflict humanity cannot be dealt with otherwise.

Salient points in relation to the themes of the workshop:

The workshop studied a number of themes; below we summarise main points of discussion

- Computer Models and the data explosion are changing the style and character of research in natural and social sciences. Causal models are increasingly displaced by statistical correlations. These methods promise great new powers for science, but also new sources of error and misuse. Quality assurance becomes ever more urgent in those fields, posing a challenge on the present digital context.

  → The use of numerical models in science for policy has exploded over the past decades This approach fits the dominant view where calculation is seen as key to well-informed good governance. It is however limited by the fact that not all

uncertainties can be expressed quantitatively in a reliable way. Number-crunching alone provides only partial and often misleading guidance on the quality of the results because it takes many things for granted, such as implicit problem frames, system boundaries, assumptions and lack of independence of the different models in the multi model ensemble. Model Quality Assessment aims to systematically assess these deeper key dimensions of uncertainty and quality.- Next ICT enabling facilities may allow science to better present a range of plausible outcomes and exploit uncertainty as an asset more than a limitation.

- There has been a 'participatory turn' in science policy, as decision-makers start to share power with citizens. It has been ten years since the Commission issued a White Paper on Governance (2001), recommending 'democratising expertise'.

  → Progress has been made, but difficulties remain, at institutional, scientific and political levels. Non-official channels of participation, as through the Internet, now compete for influence with the officially sponsored forums.

- ICT has become the technology of (making post-normal science possible, enabling 'extended peer communities' to be formed. These can interact with the mainstream, both in general criticism and even on debates on technical issues. Quality assurance in science is no longer in the hands of the experts, as (for example) 'community based auditing' provides expert scrutiny of environmentally intrusive proposals.

  → Social media facilitate powerful collaborations, counter-challenges, and story-telling across disciplinary, organizational, ideological, economic class and generational lines. But they also enable collective delusions, and it is not yet clear whether the multiple narratives in which we are entangled can be woven into a novel understanding of our place in the universe.

- 'Citizen science' now extends far beyond the traditional use of amateur observers or recorders in field sciences. Amateurs help to solve mainstream research problems (such as folding molecules, or mathematics), and also do 'garage science' on their own (DIY movement). Issues of quality, security and of safety must be recognised, but this is an exciting development. Furthermore,

  - The question of collective "intelligence' remains open; democratisation may be favoured by ICT tools. Does that create new "intelligence"?

  - Sensors and Censors: a large number of ICT applications are now deployed in cities, landscapes, atmosphere, ocean, infrastructure facilities etc. Some of them place the citizen as an active agent of information gathering and use but citizens may also become also censors of that information.

- The relations between science and other areas of knowledge are changing. The old divisions are melting, as people realise that science cannot maintain claims to objectivity remote from human nature and societal context. In the digital world, it is less plausible to accept 'nature' as a distinct entity, but rather to see that our concepts of nature, along with our knowledge of it, are the result of a socio-technical creative interaction. Also, pictures, songs and dance are accepted as real enrichments to the intellectual debates on science and policy, and direct experience of an environment is seen as enhancement of the scientific perspective.

- All images, including science images, inevitably convey values together with facts. As any other kind of visual products, they are relevant not only and not mainly for what they show, but also for *how* they show it and *why*, and at the same time, naturally, for what they *don't* show. In this scenario, artists can work either as 'evidence designers', creating sophisticated epistemic marketing device for the

newest technoscientific products, or, more hopefully, they can be become crucial actors in the process of opening a creative and productive dialogue between citizens, policy makers and scientists, about the implications of technoscientific research on the environment and society.

Further Observations about the meeting

Main interesting points regarding the square tables:

1) *Interdisciplinarity and stakeholders' participation in the coproduction of knowledge: towards a re-conceptualisation*:
>> *scientisation* of societal issues and of policy making, leads many times to Type 2 errors (i.e. solving the wrong problem); bringing different types of knowledge in issues that are policy relevant require that ethical, political, epistemological and pragmatic dimensions are interrogated. The digital society facilitates processes of scrutiny and of integration of different types of knowledge but challenges remain the same: knowledge governance, legitimacy of framings, reliability of knowledge content and sources, etc.

2) ICT: Democratisation of scientific Knowledge or democratisation of ignorance?

>> Internet is yet at its infancy, so no strong conclusions can be made, yet we should take stock of the transformations this "body" is or will potentially do knowledge production, skills and quality of what is made available there. Whilst in teaching for example, best usage of IT is till being discovered, there is also a slight danger that some skills could be lost, in particular those for participating in and contributing to democracy; also there is a danger that the notion of "information" replaces that of "knowledge", those being quite different notions. Popular search engines, as well as social networks are already strongly influencing how information flows, what information is made available, etc. Open-source seems to have the qualities of a better model to contribute to democratisation of scientific knowledge. On the other hand, what constitutes "knowledge" has to be interrogated, with new generations, since our definition of knowledge has been changing both historically and in relation to the social context.

3) science communication, Science appropriation and Public interaction with science in a Digital Society

>> on-line "official" science communication has certainly changed with the rise of Internet resources: multi-media possibilities, Wikipedia, Youtube, social networks (facebook like or twitter like), etc. The same issues are treated differently according to needs and message to be passed across by the publishers of that science. The publics of such communications are becoming also their reviewers; new uses - appropriation of, co-production and engagement with - those communications are devised; the scientific issues (including their inherent uncertainties and others arising from possible divergent sources), as well as policy and action derived become widely debatable being instrumental for publics' causes, science funders, etc. Moreover, this digital momentum is also fostering the DIY and citizen science movements. Quality and politics of science communication need review under these emerging conditions.

4) How to institutionalise post-normal science?

>> this is one of the 3 square tables focused on "post-normal science", the conceptual framing of this workshop; whilst scientific impact remains the most important factor for funding science and other factors, like social impacts are not accounted for, the post-normal science ideas cannot be fulfilled. There are many

examples of the concept at work, like Wikipedia, Cochrane collaboration for health, the emerging movement of citizen science, as well as extended deliberation in some countries about research priorities and funding such as the consensus conferences in DK, constructive technology in the NL, etc. Post-normal science ahs to be taught and therefore implies changes in the education model: cooperative pedagogy, community engagement, problem-based learning, etc.

5) For Citizens to succeed do we need engaged artists?

>> Art has values that can help with science, as art deals with complexity and the notion of certainty as it opens up spaces for questioning and provides "safe place" for exploring complex issues. Art can also be seen as a tool for messaging in communicating complex messages, although its instrumental usage can fall into "propaganda". Art has conversation echoing through many media critique, interpretations and reinterpretations of social norms, customs, beliefs and perceptions in light of past, present and possible futures, stimulating therefore conversations. The digital society provides powerful means whereby stories conveyed through art can be reached by global audiences.

6) Science Teaching Practices: does ICT matter?

>> acquiring ICT competences is utterly different from deploying ICT in teaching. Hence, training of teachers is a condition sine qua non for pupils to take stock of the opportunity of the digital society. There are successful accounts of how ICT has motivated and creatively engaged pupils in scientific activities. Learning how to dig the information market place, how to place issues and form agendas about these, are activities greatly facilitated and actually originated through the on-line resources. The Digital Society is also facilitating processes of distance learning for some time now, especial skills being need in the teaching and assessment practice. Moreover, the digital society is fostering on-line collaborations and such interactions are fundamental in science teaching. Probably, lest studied and reflected upon is how current and emerging social networks will impact on youth engagement with the scientific endeavour.

7) Science on the Digital Market Place: the role of gossip

>>gossip is not given enough attention although its importance in post—normal times is gaining a great deal of relevance; it is a form of social control which has changed over time; as such it may be both constructive and it can be a way to exclude individuals from a community. It was deemed very important for science as it can bring information about the development of a field, maintain boundaries and for establishing who's in or out of a field. In science gossip may be more effective if referring to the ethos of a discipline (fraud, etc.), or to the quality of research, methods, theories and equipment. The Internet and blogging have induced new relations between the private and public, local and global. The question remains on of what is the kind of social control performed in blogs and on the Internet, and how do these intersect with an extended local morals and norms.

8) Collaboration instead of Competition and exclusivity: new way of making science?

>>There are a myriad examples of FOSS (Free and Open Software Systems) ideas in science: Open Access publishing, open tools, open data, open notebook or portfolio. This square table suggests that mainstreaming FOSS science would imply: open and free repositories of data, models, etc.; to institutionalise non-commercial indicators measuring science quality; create incentives fo scientists to share their results, papers, etc. and identify a "business model" for science implementing FOSS ideas. The FOSS based scientific endeavour should however be interrogated for quality assurance, legitimacy and productivity advantages.

9) Scientific Publications, Extended Peer Reviewing and Intellectual Property Rights

>>IT has provided the means to speed up the review process. Moreover, the many established places for peer review to take place have already embraced some forms of post- publication commentary to scientific papers. But with the social networks, other types of review are coming along. Recent episodes of how twitter is actually making a space for article reviews prior to publication need certainly attention. Quality assurance paradoxically becomes the subject of quality scrutiny. The legitimacy of reviewers needs to be ascertained: who judges the judges? Another point made regards intellectual property rights and patenting of the artefacts arising from the DYI movement, where not-rich inventors could see their developments co-opted by big market players. The role of IT needs to be further interrogated.

10)What is the post-normal theory of transformation?

>>This square table addressed intentional or opportunistic social-ecological change as manifested by individuals or social groups, the role of post-normal science and the digital society to facilitate or hinder such process. Examples of such transformational change ranged from the large scale change such as the 17th century "Westphalian" transformation to the participants' own experiences. The discussion focused on the qualities need for such transformation to take place: willingness/ability to experiment, agility, rapid response, tightening information feedbacks, and broad awareness were mentioned. The ability of ICT to facilitate these qualities for social actors and organizations was discussed and the issue of standpoint and multiple-scales arose: one actor's broad awareness is another's surveillance. It was observed that much of the discussion of ICT revolved around current technologies and failed to envision future innovations - for example the development of robust large-scale simulation technologies might have the ability to facilitate experimentation and thus improve the ability of social actors and organization to envision alternative futures.

Finding Futures Project:

The **Finding Futures** project run in collaboration with Arizona State Univ. aimed at experimenting new ways of engaging people with debates about the future and in particular on debates about techno-science developments. The case studies of "Finding Futures" are cities around the world, with elements of transition that go unnoticed. **Finding Futures** invited participants of the workshop to join in a collective inquiry of the past, present and future of Lisbon through a walk organised on the first day. The questions posed were: What happens when you look at the city as a composite of images? How can we make the city and its contents, patterns and possibilities legible? What memories and imaginations are summoned? The results of this enquiry was a slide show of pictures taken by participants, labelled for the rational and connection to the ideas of the project. This project seems to make the case for a social research method based on experiencing materiality in human societies as a means to be able to deliberate the future. Cities are spaces where technology is created, deployed, tested and "killed" and therefore offer a good case to test the ideas of experiential deliberation in *futuring* and anticipation studies. The work done was presented and extended at S.NET 2011 conference in the Fall of 2011.

Recommendations

The following recommendations emerge from our analysis of the debates held in this workshop:

1. workshops like this one that brought together so many areas of knowledge and

expertise are needed to initiate communication across not yet open doors; they can inspire more focused activities; the debates that took place were about some of the themes that science in a digital society require, but such conversations need to be nurtured and feed each other.

2. this workshop has reinforced the idea that a deep discussion on the meanings and challenges for quality assurance in the scientific endeavour is urgent and needed. The pervasiveness of other areas of knowledge into techno-scientific developments, mostly du to the digital society tools, has generated new knowledge production and review processes that need to be interrogated and probably reviewed.

3. Specific thematic workshops and studies could be organised in the near future to address some of the emergent themes, namely:

- science in social networks - quality in numerical modelling under the pressure of humongous quantities of data - collective intelligence and citizen techno-science - DYI movement - ethics arising from science in a digital society: security, privacy and reputation,

responsibility, dignity and others - science policy in and for a digital society - quality of science in a digital society - challenges and revolutions in the scientific publishing world

Some of these proposed activities could materialise on activities for the SIDSO Action in synergy with other services interested.

4. Finally, the experience of inter-service collaborations as this one proved to be most rewarding and should be a model to follow.

Follow-up

The web site of the workshop [http://sci-ict.jrc.ec.europa.eu] will be maintained for the moment as some follow-up projects will be continued. The idea of an edited e-book with some selected contributions to the workshop is maturing and a proposal will soon be made to the participants.

ANNEX A

Keynote Speakers Addresses

Theme 1 - setting the scene

Chair: David Broster, JRC - IPTS, European Commission

>> Luciano Floridi, Univ. of Oxford, Univ. of Hertfordshire, UK and UNESCO Chair in Information and Computer Ethics

The Natural, the Artificial and the Artefactual

Abstract: Contemporary science seems to be caught in a strange predicament. On the one hand, it holds a firm and reasonable commitment to a healthy naturalistic methodology, according to which explanations of natural phenomena should not overstep the limits of the natural itself. This "closure" applies also to social and human phenomena, from economics and sociology to neuroscience and psychology. On the other hand, contemporary science is also inextricably related to technologies, especially Information and Communication Technologies, which it both exploits and fosters. Yet such technologies are increasingly "artificializing" or "denaturalising" the world, human experiences and interactions, and what qualifies as real. So the search for the ultimate explanation of the natural seems to both rely upon and promote the development of the artificial. In this paper, I try to find a way out of this apparently strange predicament by arguing that the naturalisation of our knowledge of the world is either trivial (naturalism as anti-supernatural), or mistaken (naturalism as anti-constructionism). I do so through the following steps. First, I distinguish between different forms of naturalism. Second, I show that those forms that are justified are no longer very interesting, whereas the form of naturalism that is still interesting today is now in need of revision in order to remain acceptable. Third, I argue that such a form of naturalism may be revised on the basis of a realistic philosophy of information, according to which knowing is a poietic activity through which we do not represent the phenomena we investigate, but build more or less correct informational models of them. Finally, I defend the view that the natural is in itself artefactual (an epistemic construction), and that the information revolution is disclosing a tension not between the natural and the non-natural, but between a user's and a producer's interpretation of knowledge. The outcome is a philosophical view of knowledge and science in the information age that may be called constructionist.

Bio: (Laurea, Rome University "La Sapienza", M.Phil. and Ph.D. Warwick, M.A. Oxford) is Professor of Philosophy at the University of Hertfordshire – where he holds the Research Chair in Philosophy of Information and the UNESCO Chair in Information and Computer Ethics – and Fellow of St Cross College, University of Oxford, where he directs the philosophy of information research group, IEG. In 2009, he was elected Gauss Professor by the Academy of Sciences in Göttingen, awarded the Barwise Prize by the APA, and elected Fellow of the AISB. In 2010, he was elected fellow of the Center for Information Policy Research, University of Wisconsin–Milwaukee and appointed editor in chief of *Philosophy & Technology* (Springer). In 2011, he received a *laurea honoris causa* from the University of Suceava, Romania. He is the principal investigator of the AHRC project "The Construction of Personal Identities Online" and 'scientist in charge' of the Marie Curie project "The Ethics of Information Warfare: Risks, Rights and Responsibilities". His most recent books are the *Handbook of Information and Computer Ethics* (Cambridge University Press, 2010), *Information: A Very Short Introduction* (Oxford University Press, 2010) and *The Philosophy of Information* (Oxford University

Press, 2011). His forthcoming books are: *Information Ethics*, and *The Fourth Revolution - The Impact of Information and Communication Technologies on Our Lives* (both for Oxford University Press).

>> Jean Claude Burgelman – JRC and DG RTD – European Commission & David Osimo, Tech4i2 ltd, BE

Science 2.0 – change will happen…

Abstract: Advances in information and communication technologies such as social networks, cloud computing and ubiquitous sensors are removing barriers to entry and revising the way people collaborate and publish. This is happening already and impacting the scientific world. In particular, we identify 3 main trends: a proliferation of scientific authorship, the fragmentation of research outputs and the increased availability of data. The combination of these three trends is leading to a transformation of the very nature of doing science, and therefore science policy. Among the expected impact of this transformation, we consider:
A more unequal distribution of influence, with resources being concentrated on a few world-class researchers and research centres;
A disruption of the value chain of scientific production, with a particular difficulty for publishers to maintain their role as "gatekeepers";
A blurring of the boundaries between scientific and cultural production;
A new model of science, thanks to unprecedented data availability, where correlation supersedes causation;
An increased importance of reputation, and the adoption of more open reputation management systems of scientific careers
An increased influence of scientists more able to communicate

Bio [Jean-Claude BURGELMAN]: Jean-Claude Burgelman joined the European Commission in 1999 as a Visiting Scientist in the Joint Research Centre (the Institute of Prospective Technological Studies - IPTS), where he became Head of the ICT unit in 2005. In January 2008, he joined the Bureau of European Policy Advisers as adviser for innovation policy. Since 1-10-2008, he joined DG RTD, as advisor and then Head of Unit in charge of Research of top level advisory boards like the European Research Area Board. Till 2000 he was full professor of communication technology policy at the Free University of Brussels, director of the Centre for Studies on Media, Information and telecommunication and involved in science and technology assessment.He has been visiting professor at the University of Antwerp, the European College of Brughes and the University of South Africa and sits on several academic journals.He chaired and is now a member of the World Economic Forum's Global Agenda Council on Innovation as well as a member of its Science Advisory Committee.

Bio [David Osimo]: joined Tech4i2 ltd as Director in 2008. He has 15 years of experience as advisor on information society and innovation policies in a variety of settings, inside and outside government, at local and international level, his latest assignment being coordinator of eGovernment research at the European Commission Joint Research Centre (IPTS). He is mostly known for his pioneering work on web 2.0 in government, but he authored articles and reports on a wider variety of topics, including future government, public procurement, new innovation models, research policy, ICT statistics. He is an experienced keynote speaker but he also tries to make a difference as a policy "hacker", as for example in 2009 when he designed the Open Declaration on Public Services (http://eups20.wordpress.com) and the Innovative and Creative Application awards (www.inca-award.be). He blogs at http://egov20.wordpress.com and tweets @osimod.

Theme 2 – modellers' challenges…

Chair: Serafin Corral Quintana, ULL, ES

>> Andrea Saltelli, JRC - IPSC, European Commission

Melt down Modelling

Abstract: The use of mathematical models in the absence of reality checks can be held responsible for a crisis of credibility in models. Among the antecedents of this crisis are the works of mathematician Saunders Mac Lane, of biologist Robert Rosen and of philosopher Jean Baudrillard, while the issue is popularized today by Nassim Nicholas Taleb in Economics, and Orrin H. Pilkey and Linda Pilkey Jarvis in Environmental Sciences. In spite of all this we are still told today that larger models are needed, why the practices associated to model use and quality remain pitiful. Silvio Funtowicz has seen into this crisis early on, and -- together with a brave group of scholars, has developed lenses to see through the ruse. In the presentation I will tell the story the way I learned it, and how it has found expression in my work on sensitivity analysis.

Bio: Worked on physical chemistry, environmental sciences and applied statistics. His main disciplinary focus is on sensitivity analysis of model output, a discipline where statistical tools are used to interpret the output from mathematical or computational models - an issue which the digital society and distributed computing will not alleviate. A second focus is the construction of composite indicators or indices. Presently leads the Econometric and Applied Statistics Unit of the European Commission at the Joint Research Centre in Ispra (I). The Unit, with a staff of 25, develops econometric and statistic applications, mostly in support to the services of the European Commission, in fields such as lifelong learning, consumer empowerment, employment, competitiveness and innovation. He participates to the training of European Commission staff on impact assessment.

>> Jeroen Van Der Sluijs, Univ. Utrecht, NL

Model Quality Assessment: progress and challenges

Abstract: Driven by the availability of ever more rapidly growing computer power, the use of numerical models in science for policy has exploded over the past decades. For instance in climate modelling it has enabled a shift from deterministic instantaneous CO2 doubling experiments to transient perturbed physics ensemble modelling and multi model ensembles. This approach fits the dominant view where calculation is seen as key to well-informed good governance. It is however limited by the fact that not all uncertainties can be expressed quantitatively in a reliable way. Number-crunching alone provides only partial and often misleading guidance on the quality of the results because it takes many things for granted, such as implicit problem frames, system boundaries, assumptions and lack of independence of the different models in the multi model ensemble. Model Quality Assessment aims to systematically assess these deeper key dimensions of uncertainty and quality. Starting from the notion that models are tools, not truths and that a model is not good or bad but there are 'better' and 'worse' forms of modelling practice, it seeks to systematise critical reflection on uncertainty and quality in terms of fitness for function. The talk will review progress and prospects for tools for Model Quality Assessment such as pedigree analysis, assumption analysis and quality checklists.

Bio: he is a Senior Researcher and Associate Professor at Department of Science Technology and Society, Copernicus Institute for Sustainable Development and Innovation, Utrecht University and Invited Professor at Recherche en Economie-Ecologie, Eco-innovation et ingénierie du Développement Durable, Université de Versailles Saint-Quentin-en-Yvelines. He has a background in chemistry (MSc, 1990, Leiden University) and did his PhD on uncertainty management in climate risk assessment (1997, Utrecht University). His research focuses on coping with uncertainty in science for policy in the domains of complex environmental and health risks from (novel) technologies. Jeroen (Co)-authored 53 peer reviewed journal articles and about 25 peer reviewed book chapters and more than 100 other scientific publications in the fields of risk analysis of new and emerging risks, the Precautionary Principle, Uncertainty management, NUSAP, Uncertainty methods, Climate Risk Assessment, Expert Elicitation, Stakeholder Elicitation.

>> Mario Giampietro - Universitat Autonoma de Barcelona (UAB) and Institute of Environmental Science and Technology (ICTA), ES

Achilles' heel of computer modelling: the TAO cannot be NAMED

Zen title: We know and agree that "**snow**" is white, but would it possible to agree on the "true" colour of "**ktulubuk**"?

Abstract: (1) According to the modelling relation proposed by Robert Rosen any quantitative representation of a given narrative about the external world necessarily reflects a given pre-analytical perception of a relevant situation. This pre-analytical perception of relevance has to be provided by a story-teller. Only after this pre-analytical decision, scientists can start their work, generating quantitative representations developed within a narrative, which has been defined as relevant by society.

(2) In any semiotic process, the truth of a formal statement – e.g. a given quantitative representation generated by a model – can only be validated in relation to its effectiveness in guiding action. Therefore, this validation implies the pre-existence of: (i) a goal – a relevant issue to be tackled - in relation to which the predictive model has to show its usefulness; (ii) an institutional setting capable of deciding about both the relevance of the issue and the validity of the model. That is, only after having gone through the whole semiotic cycle it becomes possible to check whether or not a given anticipatory model - a hypothesis of causality, a quantitative prediction, an assumption about the usefulness and/or harmless of a new technology – is "true".

(3) When dealing with a situation of a rapid technological progress and a weakening cultural identity of society, it is unavoidable to face the predicament typical of Post-Normal Science. The society is facing totally new challenges, which require quick responses, facing large doses of uncertainty and without being able to define clearly an identity for the "story-teller" at the level of the whole society. This fact translates into the need of producing, evaluating and using scientific information in relation to governance at a speed, which exceeds human ability to handle such a challenge. The digital society in spite of the skyrocketing increase in the flows of information and computational capability seems to be less and less capable of providing the required quality control on the process of production and consumption of scientific information for governance, especially in relation to quantitative analysis.

(4) Larger information flows and larger computational capability can improve or worsen the situation depending on how they are used. A larger and more complex information space can become a liability if not properly handled. As a matter of fact, the modelling relation theory developed by Robert Rosen can be used to show that when dealing with complex issues, the validity of the results of computer modelling is heavily affected by ideological assumptions (the pre-analytical decision of

the story-teller about the narratives to be considered as relevant). This problem is exacerbated by the proposed use of scientific reductionism – i.e. the use the concept of risk/probabilities and scientific expert opinions - to provide a virtual closure to "the semiotic process", also when dealing with problems affected by large doses of uncertainty. Whenever reductionism is used to avoid the difficult discussion of whose definition of relevance counts (how to deal with the co-existence of non-equivalent legitimate story-tellers) increasing the computational capability of computers really does not help.

Theme 3 - information and communication technologies and post-normal science

Chair: Viriato Soromenho Marques, Univ. of Lisbon and Calouste Gulbenkian Foundarion, PT

>>Jerome Ravetz – Institute for Science, Innovation and Society in Oxford, UK

The Politics and Political Economy of Science in the Digital Age

Abstract: The tendency of capitalism to constantly revolutionise the means of production, and consequently the social relations of production, has not had much attention recently. In technology, the twentieth century was really a footnote to the nineteenth, rather as in science the eighteenth was to the seventeenth. The conquest of matter and the creation of new forms of energy in the Victorian age laid the foundations for the technology of information which has only recently arisen. This new technology has fostered new styles of the management of property and power, which recall some older idealistic visions. In Open-Source software development, Creative Commons property, and the whole Wiki movement, new relations of property and governance emerge. The hierarchical corporate command structure becomes diluted by networks of collaboration with fully-competent workers who also want to have fun. Now the spectre of Peter Kropotkin comes back to haunt the devotees of Herbert Spencer. In these new industries, 'mutual aid' turns out to be a profitable corrective to the 'survival of the fittest' ideology of dog-eat-dog capitalism.

Mainstream science has just begun to recognise these new tendencies in its own special area. While 'priorities' is the language of science governance in pragmatic policy formation, the dominant social realities of the 'industrialisation and incorporation' of science, and of its integration into the social systems for serving power, profit and privilege, are still largely ignored. The social relations of mainstream research science are still those of a strictly guided meritocracy. The systems of research support and quality-assurance of results also function as effective tools of social control. Unfashionable research topics, and even unfashionable research results, are noted and discouraged. Although 'participation' by the public in the formation of policies relating to science is an official desideratum, it is still grudgingly granted as a privilege and then tightly manipulated in practice. The involvement of amateurs in research, while growing rapidly thanks to the Internet, is still conceived in terms of the use of volunteers for the less demanding tasks.

The most noticeable change so far in the politics of science in the digital age has been the emergence of an Extended Peer Community on the critical blogosphere. So far this has focused on the Climategate issue. I have argued elsewhere that this presence was critical; otherwise the hacked emails could have been explained away as the human responses of harassed scientists, and the independent critics could have been picked off one by one as they were during the BSE scandal. The whole Global Warming affair has been hideously complex; suffice to say that by taking a position nearly totally lacking in nuance, the leadership of the British scientific community has damaged itself badly. One sign of its defeat is the attainment of respectability in their own sphere by the critical voices. The accolade of 'best science blog' repeatedly won by www.wattsupwiththat.com is a very important political statement, which is supported by the site's record of 46 million visits so far.

Nothing in the various 'public understanding of science' initiatives is in the same league of popularity or influence.

This new oppositional politics of science, so easily seen as a threat to the established order, could explain the recent virulent and deeply counterproductive declamation by Professor John Beddington, the UK Chief Scientist. He not merely said that we should be 'intolerant' of certain critics as much as of racists and homophobes, but that we should be 'grossly intolerant' of those who resort to 'cherry-picking of the facts'. What sorts of actions should implement the principles of being 'grossly intolerant' were not specified, nor were the targets. Since he mentioned religion, we can conclude that Creationists were on his mind. Otherwise we can only surmise that he was thinking of those who oppose the global-warming official consensus, civil nuclear power and genetically modified foodstuffs. It is unlikely that he was attacking the supporters of neoclassical economics. Such an unprecedented outburst, whose language could so easily be interpreted as a signal for a witchhunt of dissenters, is a sign of a deeply troubled state, either in an individual or in the institution he represents.

John Beddington's call reflects the emerging new critical politics of science. Perhaps even more significant is the emerging new political economy of science in the digital age, occasioned by the rise of an independent sector of research. Although it is still very marginal, it cannot but grow in size and influence. For this development, some history provides an explanation. In many ways the production of scientific knowledge has resembled that of material commodities. Up to the nineteenth century, research in most fields (astronomy being the great exception) required resources of the same order of magnitude as those of an individual patron. But just as the independent craftsmen were destroyed by the 'capitalist' with his mill, the independent 'gentlemen of science' gave way through the Victorian period to the professional 'scientists', employed in large institutions and provided with access to large-scale resources. As I observed above, this 'mode of production' of knowledge had its own politics, where the provision of resources and the maintenance of quality-assurance also functioned for social control.

Now the technologies of matter and energy are giving way to those of information, in the knowledge-production industries as well. 'Biopunk' and 'Hackteria' are still new and marginal; but as the relevant technologies become ever more cheap and powerful, they will grow and synergise in unpredictable ways. New internet communities are being created where knowledge will be shared and created as never before. The closed world of journal refereeing is already being diluted with internet systems. As a community grows that doesn't need traditional journals at all, the challenge to inherited systems of quality-assurance and governance will be direct. There will be instabilities and huge risks, as 'malware' extends from computer software to research products. On the other hand, the processes of democracy will be enhanced. The control of public access to scientific knowledge by the official sources will be seriously weakened. 'Science for the people' could at last become a realistic programme. For some idea of what it could be like, we can think of the Reformation, enabled by the invention of cheap printing whereby every man could interpret the Bible and also think of publishing a pamphlet about it. For this analogy we think not only of the doctrinal, organised movements of the 'Magisterial Reformation' of Luther, Calvin and their rivals, but also of the 'Radical Reformation', confused and chaotic, promoted by every sort of enthusiast, but in the long run profoundly creative.

All this is a vision for the intermediate future. These tendencies will not mature immediately. But within much less than a generation this prospect will need to be addressed seriously. Whether the leaders of the established scientific communities could make such a huge revolution in their paradigms about science itself, is very much an open question. But ignoring the future of science in the digital age will not stop it happening.

>> Cristina Gouveia – YDREAMS, PT

Do it yourself and Collective Intelligence

Abstract: Citizens have always created information and shared it with the broader community. Such initiatives have been used to keep communities, elected officials, and government agencies informed about the problems that need to be addressed. However, ICT tools have changed the impact of citizen initiatives not only by increasing the dissemination and access, but also by creating new tools for data collection, analysis and visualization. Society has now an opportunity to tap into collective intelligence and is searching for ways to promote collaborative work to solve problems and develop innovations. The emergence and popularization of terms such as Citizen Science, Volunteered Geographic Information and Crowdsourcing reflects this search for frameworks and tools.

In the area of ICT tools two major trends are shaping the way citizens become involved: 1) the ubiquity of sensors and social networks and 2) the emergence of Do It Yourself (DIY) movement. The ubiquity of sensors and social networks has created new opportunities for data collection and analysis. For example, the highly available consumer GPS devices allow citizens to collect increasingly precise location information and create maps that were previously only created and owned by highly specialized companies or institutions. The popularization of social networks allows using collective intelligence mechanisms, like the ones used in the DARPA red balloon challenge, which is based in exploring the human factor. Additionally, the social networks have gone further than connecting people and they now include a diversity of tools to collect and aggregate information. Webmapping tools and *mashups* such as the ones used in the OpenStreetMap project, and the predictive markets are two of many examples. The emergence of DYI movement is based on the increasingly availability of tools for personal digital fabrication. Arduino, an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software, is an example of an increasingly popular platform allowing users to create their own devices that measure and disseminate the information they are interested in. This trend will allow to citizens to shape the Internet of Things and opens new possibilities for creating tools that take advantage from the wisdom of the crowds. In this presentation this two trends are reviewed and some examples are presented.

Bio: She has a PhD in Environmental Engineering from the New University of Lisbon and a Master of City Planning from MIT. Her main area of research is the use of information and communication technologies to support environmental management ranging from monitoring to decision-making and public participation. Cristina Gouveia is currently a researcher at YLabs the YDreams R&D division. Email: cristina.gouveia@ydreams.com

>> Franco Accordino – DG INFSO, European Commission

ICT and the advent of the 'Digital Science'

Abstract: Today's scientific landscape is characterised by two inter-related trends. On the one hand, the availability of advanced computing and data infrastructures enables, more than ever, to collect and process data throughout the scientific discovery process, enabling researchers to build more and more accurate "digital" models and to perform detailed simulations, for example, of the innermost properties of nature. On the other hand, the widespread use of "participative" web paradigms in the scientific process enables researchers to share data, models, software tools, papers and (re)views. It stimulates creativity and opens up new perspectives for global multi-disciplinary networking and collaborations. These trends, which we can call the "Digital Science", are driving a cultural change in the way scientific knowledge is produced, disseminated and ultimately transformed into value. The change affects research, higher education, innovation, but also societal issues such as trust, reputation, accreditation and ethics. ICT is at the hearth of these transformations, not only as a discipline genuinely depending on scientific advances, but also as a fundamental technology which is

enabling a new era of discoveries and mindset changing in all sciences. The presentation will introduce the policy context set by the "Digital Agenda", with particular emphasis on ICT research, education and innovation aspects, as well as the related activities currently developed by the European Commission in the field of science-driven ICT research (e.g. FET young researchers), e-Infrastructures (e.g. open access) and ICT scientific societies.

Bio: He is a scientific officer and strategy adviser to the Director of "Emerging Technologies and Infrastructures" within the European Commission's Information Society and Media Directorate-General. He works mainly on the development of a vision and strategy for future ICT, with particular focus on future and emerging technologies (FET), e-Infrastructures and virtual research communities including research networks, supercomputers, grids and data infrastructures, new paradigms and experimental facilities for the future internet, ICT for trust and security. Recently, Franco has been appointed as the leader of the Directorate General's project "Digital Futures". Before joining the European Commission, he worked at the ETHZ/CSCS National Supercomputing Centre of Switzerland, at Consorzio Pisa Ricerche and at the National Research Council of Italy where he conducted research on formal methods, languages and tools for concurrent systems and protocol specification. He has a long-standing experience in several information technology fields, including formal methods and software engineering, grid and distributed systems, operating systems, web-based applications and services and knowledge discovery in databases.

Theme 4 – citizens science

Chair: Cynthia Selin, Arizona State Univ., USA

>>John Robinson, University of British Columbia, CAN

The Greenest City Conversations Project

Until recently, the dominant trend in both research and practice on the promotion of sustainability behaviour has been to focus on the provision of information in order to change people's attitudes, beliefs, and subsequent *individual* behaviour (Gardner and Stern, 1996). These interventions were based on an information deficit model, which suggested that provision of new information was a major driver of behaviour change (cf. Ajzen and Fishbein, 1980). Decades of research have demonstrated, however, that there is a very weak relationship between the provision of information and sustainability behaviour (Hines et al., 1986/1987; Stern, 2000). Research has also shown that that people are particularly resistant to changing individual behaviours and habits that they see as impacting their quality of life (Bord et al., 2000; Shove, 2003).

Research in sustainability behaviour also recognizes that it is insufficient to simply provide one-way information to stakeholders and the public; rather it is important to engage in a two-way dialogue that facilitates emergent forms of knowledge (Robinson and Tansey, 2006). Arguments for the inclusion of participation on issues of public concern include the **normative** (people's democratic right to participate), the **instrumental** (participation improves trust and support for policies), and the **substantive** (participation actually improves the quality of decisions) (Stirling, 2006). Applications such as Participatory Integrated Assessment, and planning charrettes, represent approaches with both a focus on participation, and on collective action (Girling et. al, 2006; Salter et al., 2010).

Another strand of recent arguments suggests that to more fully engage with different 'publics' participatory processes must address the 'more than rational' and foster reflexivity beyond the cognitive domains, i.e. aesthetic, hermeneutic, ontological and professional (Dieleman, 2008; Kagan, 2008).

The Greenest City Conversations (GCC) project provides the opportunity to further both theoretical and practical knowledge on collective sustainability behaviours, and methods of public engagement. GCC is aimed at testing multiple channels for public engagement on sustainability policies. Its two main goals are (1) to facilitate discussion, solicit and analyze public attitudes and opinions on, and support for, a variety of sustainability policies; and (2) to provide a comprehensive understanding of the content and impacts (both qualitative and quantitative) of six different modes of public engagement ("channels"):

- social media,
- multiplayer touch games,
- workshops with visualization,
- mobile computing,
- scenario analysis and gaming, and
- performance art.

The project will engage the public of Vancouver in each of these channels and qualitatively analyze the content and modes of interaction used in most channels for aspects such as cognitive, affective, narrative, normative, sensory, embodied, and motivational components, in order to assess *how* different channels may engage the participants. We will also analyze the impacts of most channels on participants' views of sustainability issues in Vancouver (tied to specific City of Vancouver targets, objectives and policies), and trace changes in their sustainability-based opinions.GCC channels are connected through an online hub of information about the project and a portal to the web presences of the various engagement pieces. The project in intended to discover insights for both for the City of Vancouver policy and for participation theory.

Bio: He is the Executive Director of the UBC Sustainability Initiative, responsible for leading the integration of academic and operational sustainability on the University of British Columbia's Vancouver campus. He is also a professor with UBC's Institute for Resources, Environment & Sustainability, and the Department of Geography. Dr. Robinson's own research focuses on the intersection of climate change mitigation, adaptation and sustainability; the use of visualization, modeling, and citizen engagement to explore sustainable futures; sustainable buildings and urban design; creating partnerships for sustainability with the private, public, non-governmental and research sectors; and, generally, the intersection of sustainability, social and technological change, behaviour change, and community engagement processes.

>>Philip J. Tattersall - Univ. of Western Sydney, AUS

Citizen Science in the Post Normal Moment:: Citizens as Effective Inquirers in the Digital Age

Abstract: Since the 1970's there has been a steady rise in citizen science around the world. It has risen to prominence in Europe in the form of science shops, which led to an international network. The demand has been high with communities contributing to the 'bottom up' knowledge processes. Citizens are afforded the opportunity to participate on many levels and be part of creating programs in many branches of science. In Australia, citizen involvement in environmental monitoring is facilitated under Federal government programs such as Landcare and Waterwatch.

While the above programs and initiatives help engage citizens in science there are questions as to whether they are able to accommodate inquiry into contentious community concerns and issues. Experience in Tasmania has shown that Landcare and Waterwatch programs are not always able to adequately embrace calls for inquiries from the community in relation to natural resource management issues. This has led to conflict and in turn caused citizens to undertake their own inquiries and research through an innovative form of citizen science.

With reference to activist styles the presentation discusses the rise of citizen science as a special form of public participation. Citizen science is discussed in terms of 'Effective Inquiry' where citizen participation and ownership are maximized beyond those of 'data collector, informer or protester'. It is suggested that the subtle redefinition of activism where citizens are becoming more and more involved in issues of concern will be further boosted by ICT's. An emerging form of citizen science, Community Based Auditing (CBA), is seen as one way to engage citizens in a user friendly, yet sophisticated approach to direct involvement in knowledge creation through critical inquiry. Experiences over the past 12 years have shown how CBA not only enables inquiry into issues of concern but also invites change within individuals. This leads to increased competency and greater focus on self reliance and cooperation among citizens and less reliance on issues based activists and 'experts' with possible agenda of their own. As CBA operates within the frame of Post Normal Science (PNS) citizens are also encouraged to actively question and inquire into the quality of the science that underpins their issues of concern. As CBA invites participation through Action Research citizens are encouraged to develop and continue ongoing inquiry conversations. The role of ICT's such as Skype, Twitter, email and Facebook are on the increase.

While of great benefit, these rapid, high volume forms of communication also have downsides as there are always risks, such as release of poorly or non-peer reviewed information, which could 'go viral'. Therefore there are important ethical and social responsibility aspects to this new found freedom. As with 'conventional science', questions regarding quality control, authority and judgment calls all loom large. ICT time-frames will be short; stakes may be very high and decisions uncertain – all very Post Normal.

Bio: Over the past 30 years Philip Tattersall has worked in partnership with concerned communities in Tasmania, Australia. As a scientist-activist he continues to support the emergence of what he terms the 'inquiring citizenry'. Phil is qualified in applied and analytical chemistry, and holds qualifications in Sustainable Agriculture and a M.Sc. (Hons) from University of Western Sydney. He has also qualified as an ISO 14001 internal auditor. He is currently working on his Ph.D, in which he is researching the role of Post Normal Science (PNS) in the evolution of *inquiring communities*. He is also developing new *citizen science* tools, such as his recently developed methodology *Community Based Auditing.* He has published over 30 papers and articles and has recently published two books.

>>Robin Smith – Inst. For the Environment and Sustainability, European Commission

Digital Earth as a Framework for Advancing Science in the Digital Society

Abstract: The initial vision of Digital Earth was articulated by Al Gore in 1998 as a multi-resolution, three-dimensional representation of the planet that would make it possible to find, visualise, and make sense of vast amounts of geo-referenced information on the physical and social environment, for scientists, policy-makers and children, alike. Such a system would not only allow users to navigate through space but also time, by accessing historical data and making predictions based on, for example, environmental models. Since then, tools such as GoogleEarth and Microsoft's Virtual-Earth are offering the opportunity to interact with geospatial data for hundreds of millions of users, while spatial data infrastructures at national, European (INSPIRE), and global levels are helping to open-up vast, rich stores of public sector information for scientists, civil society and business. Three developments are now promising to move us even closer to the vision of Digital Earth: (i) the massive deployment of web-enabled sensors that measure physical parameters in (near) real time; (ii) the dramatic uptake of social networks, where citizens can report observations and perceptions of their changing social and physical environment (adding a rich dimension to integrated policy assessment); and (iii) research taking us beyond the interoperability of data and services, to the interoperability of

online models across disciplinary boundaries. In 2010, the International Council for Science (ICSU) argued that one of the current, most fundamental challenges facing humanity is to undertake global sustainability research to respond to the increasing pressure on the environment and human society; where they identified five scientific priorities:

- Developing the **observation** systems needed to manage environmental change.
- Improving the usefulness of **forecasts** of future environmental conditions.
- Recognizing key **thresholds** or non-linear changes,
- Identifying institutional, economic and behavioural **responses.**
- Encouraging **innovation** to achieve global sustainability.

To address these 'Grand Challenges' effectively, ICSU also argued that there is a need to move away from natural science-dominated research towards interdisciplinary and *transdisciplinary* research involving all the sciences and humanities. We see Digital Earth as the framework to address such challenges, as it builds on observations coming from heterogeneous networks of sensors which measure environmental status (etc.), helping to improve our modelling and forecasting capabilities. Through social networks, such activity also includes citizens, helping to foster increased social awareness and responsibility, while providing public access to scientific outputs helps to build trust in science, develop a shared understanding of problems, and move us towards collective action for sustainable solutions. This presentation will outline the current vision of Digital Earth within the scope of citizen science. It will discuss the role of Volunteered Geographical Information through 'citizen-sensors' to monitor environmental condition, including in hazard related situations. This will include recent work analysing the potential role of citizen-generated content in social networks when detecting and managing wildfires across Europe, alongside some key research issues when considering such socio-technical phenomena in the geospatial context.

Bio: He studied Ecological Science at the University of Edinburgh and has a Masters in town planning research and a PhD from the University of Sheffield, where he looked at emerging forms of 'digital participation' involving citizens in local decision-making. As well as a number of interdisciplinary projects in public health, social/environmental sciences, and work on e-(social) science, his research has focussed on Spatial Data Infrastructures (SDIs) at different levels of government and in different sectors. From 2001-2004 he was assistant-coordinator of the Geographic Information Network in Europe project before becoming both the GIS Analyst for an interdisciplinary research centre at the University of Sheffield and 'track-leader' for ICT research at the South East European Research Centre in Thessaloniki, Greece. Robin is currently working in the EC Joint Research Centre on the SEIS-BASIS initiative. This project aims to address the varying data access and data quality issues found in environmental monitoring within the context of the European Shared Environmental Information System (SEIS). In addition, he is helping to evaluate both developments in INSPIRE and the use of Volunteered Geographic Information in environmental and hazard monitoring. E-mail: robin.smith@jrc.ec.europa.eu.

Theme 5 – participatory turn of science

Chair: Bruna De Marchi, Independent Researcher, IT

>> Angela Liberatore – DG RTD, European Commission

Democratising Expertise: Ten Years After

Abstract: What did we learn from the work on 'Democratising expertise' in the context of the Commission's White Paper on Governance of 2001 ? What challenges remain open, which new ones are to be addressed - and where do we seem to witness some un-learning? In light of such questions - and in view of developing collective answers, some reflections will be offered - also linked to practical examples. In particular the following challenges in relation to democratising expertise in different contexts/for various actors will be briefly discussed:

a) administrative challenges: overcoming technocracy, but retaining intelligence (example: ex ante Impact Assessment procedures)
b) scientific challenges: engaging with public debate on results and also on processes (example: 'Climategate')
c) political/policy challenges: managing uncertainty - quantity vs quantity and pluralism of information (lessons from Chernobyl and Fukushima)

Some modest and tentative conclusions will be offered for further debate and analysis.

Bio: She works in the Directorate General for Research and Innovation of the European Commission, Unit Social Sciences and Humanities, on issues of global governance, geopolitics, human rights, conflicts and security.
She holds a PhD in Political and Social Sciences (European University Institute) and a degree in Philosophy (University of Bologna).
Her most recent publications concerns the relations between security policies, democracy and fundamental rights e.g. *Transatlantic convergence or divergence? Threat assessment, Surveillance Technologies and Fundamental Rights*, in Yannis Stivachtis ed., International Order in a Globalising World, Ashgate, Hampshire; *'Balancing Security and Democracy, and the role of expertise: The Politics of Biometric Identification in the EU'* (European Journal of Criminal Policy and Research, 2007). Other publications include 'The Management of Uncertainty. Learning from Chernobyl' (Gordon&Breach/Routledge, 1999), 'Governance and democracy : reflections on the European debate,(in Good Governance, Democratic Societies and Globalisation, edited by S.Munshi and B.P.Abraham, Sage 2004) and various articles on science/policy relations, risk management, environmental policy, European integration and governance issues.

>> Eshan Masood, NATURE, UK

Peer review in a digital world

Abstract: Scientists, policymakers and publishers regard peer review as the gold standard in science. But how true is this in a world where the very idea of expertise and authority is open to question. Does conventional peer review make sense in a world in which anyone with a cellphone, a WiFi connection and a Twitter account is both reader and reviewer? It is tempting to write off conventional peer review as yesterday's news, but it is also premature. Peer review has a long history and has more strengths than it does weaknesses, and plenty of room to improve. Technology can be a catalyst for that change. But what technology cannot do is to create a revolution.
Bio: Ehsan Masood is the Editor of Research Europe magazine and its UK sister title Research Fortnight. Based in London he also teaches international science policy at Imperial College and

presents documentary programmes for BBC Radio 4. Ehsan trained as a science journalist and spent many years working for the journal Nature, most recently as Chief Commissioning Editor. He is the author of a number of books, the most recent of which is Science and Islam: a history (Icon, 2009). His most recent outing for the BBC was a programme called Scientists of the Subprime, which explored the role of science in the financial crisis. Follow him on twitter.com/ehsanmasood

Theme 6 – science and other areas of knowledge

Chair: Sofia Guedes Vaz, New Univ. of Lisbon, PT

>>David Waltner-Toews – Univ. of Guelph, CAN

Science, Social Media, and Surfing Pandemic Waves

Abstract: Since the late 1980s, the world has faced an apparent pandemic of pandemics – most originating in other animals, and/or disseminated through the complex eco-social systems we share. These have included BSE (Mad Cow Disease), SARS, HIV-AIDS, Influenzas (including so-called bird flu and swine flu), Salmonellae (mostly foodborne), E.coli 0157:H7, radionuclides in food (post Chernobyl as well as post-Fukushima) and a plethora of smaller outbreaks and epidemics. Both the characterization of these events, and the responses to them, have been shaped by narratives articulated in social and digital media. How this digital information scatters, regroups, recombines and evolves evokes metaphors from biology (eg computer viruses), but also, in substantive ways, interacts with and influences the biological phenomena they describe. For instance, a private company specialising in global threat and risk identification claims to have reported the emergence of the H1N1 virus 18 days before the U.S. medical authorities. The rapid dissemination of this information influenced public policy, vaccine development and delivery, and altered the evolution of both the viral systems and social systems. These kinds of events have changed the nature of health-related sciences, peer-review, health care, economics and the definitions social-cultural entitlements. In the search for the causes of causes in a complex world, evidence gathering systems (aka surveillance) are now able to track “syndromes”, and changing cultural habits (food, pets, agriculture, trade, travel). This surveillance has the noble aim of seeking to prevent disease emergence. As with all preventive measures, success is measured by non-events and hence remains radically uncertain. Furthermore the science – and the narrative - behind this is still linear and statistical, and organizations struggle to package complex phenomena into “stages of pandemic”, or “food-borne”, “mosquito-borne”, “zoonotic”, “swine flu”, “Mexican flu”, or “bird flu” and to draw causal links to controllable antecedents. Indeed we appear to be surfing cresting cross-currents of change in pursuit of (or fleeing from) zombies, the “undead”. The notion of a zombie has its origins in West African Vodun religion, in which a person is controlled by a sorcerer through some combination of psychoactive drugs and powerful socio-cultural anticipatory models. In some fictional versions, zombies, as victims of a mysterious pandemic, desire to eat human flesh, particularly brains. Similarly, digital media enable us to devour pre-packaged ideas and keep boxy anticipatory systems in jerky motion long after they should be credibly dead. Because the underlying reality is not so neatly parcelled, we are still surprised by unforeseen tipping points and catastrophes. In our entranced state, we are surprised when the wave strikes a shoreline and scatters. Social media facilitate powerful collaborations, counter-challenges, and story-telling across disciplinary, organizational, ideological, economic class and generational lines. But they also enable collective delusions, and it is not yet clear whether the multiple narratives in which we are entangled can be woven into a novel understanding of our place in the universe, or whether we will be left floundering in tide-pools of a fragmented, anxiety-ridden, Dostoyevsky-esque novel.

Bio: He is Professor in the Department of Population Medicine at the University of Guelph, founding president of Veterinarians without Borders/ Vétérinaires sans Frontières – Canada (www.vwb-vsf.ca) and the Network for Ecosystem Sustainability and Health (www.nesh.ca). In 2010, he was awarded the inaugural award for "Outstanding Contributions to the field of EcoHealth" by International Association for Ecology and Health and was featured in the "Speakers of Renown" series celebrating the 40th anniversary of Canada's International Development Research Centre. He has published more than 100 peer-reviewed scientific papers; his books include "The Ecosystem Approach: Complexity, Uncertainty, and Managing for Sustainability" (edited, with Nina-Marie Lister and the late James Kay, 2008), half a dozen books of poetry, a collection of recipes and dramatic monologues, an award-winning collection of short stories, a murder mystery, and eco-cultural and evolutionary introductions to zoonoses, (The Chickens Fight Back, 2007), and foodborne diseases, (Food, Sex and Salmonella, 2008).

>>Alice Benessia – I.R.I.S. – Interdisciplinary Research Institute on Sustainability, Univ. of Torino, IT

Science imagery in the digital age: Some reflections on the contemporary techno-scientific heroism of vision

Abstract: Visual language is essential for understanding and sharing experimental results within the science community; most recently, it is crucial not only for communicating new technoscientific insights, but also for educating and/or persuading the public at large (citizens as well as decision makers). The new and constantly evolving image-processing technologies allow manipulating raw scientific data in more and more sophisticated ways. New guiding principles for producing visual evidence, essentially arising from standardized aesthetic concerns, pervade science labs and specialized literature, mixing a variety of expertise, creating new controversial kinds of imagery, bridging epistemic, methodological and normative gaps in unexplored ways. Scientists are encouraged and trained to produce images that work for submissions to professional journals as well as for citizens at large, therefore occupying the territory of science education and communication. At the same time, image-makers of various sort, going from image-processing amateurs, to image designers, all the way to professional animators and visual artists, have a growing role in creating the contemporary techno-scientific visual discourse. As a result, the borderline between visual evidence and elaborated design products is now very thin. All images, including science images, inevitably convey values together with facts. As any other kind of visual products, they are relevant not only and not mainly for what they show, but also for *how* they show it and *why*, and at the same time, naturally, for what they *don't* show. In this scenario, artists can work either as 'evidence designers', creating sophisticated epistemic marketing device for the newest technoscientific products, or, more hopefully, they can be become crucial actors in the process of opening a creative and productive dialogue between citizens, policy makers and scientists, about the implications of technoscientific research on the environment and society.

In order to open a space for reflection on these issues, we will briefly review a few examples of scientific image making processes, in light of some considerations coming from the arena of the history of photography. In one of her most influential collection of essays, titled "On Photography", Susan Sontag articulates the development of photography in the modern era as a tension between beautification (art) and truth telling (science). The heroism of vision of the photography pioneers was considered to be about exploring unknown geographical, social and natural territories and being able to convey their wonders to a large unaware public. This modernist attitude towards the creation of a "new vision" for the people, from the Bauhaus "hygiene of the optical" to the epic transcendent vision of natural order of Paul Strand and Edward Weston, has been surpassed long ago, by more than one generation of photographers, both in Europe and in the US: from the emergence of the

nineteen fifty street photography and its connections with Beat literature, poetry and jazz all the way to contemporary staged photography, such as the one of Jeff Wall. We will argue that if, on the one hand, the scientific visual discourse in the digital age is quite complex in terms of its making and sharing, on the other hand, in term of its aesthetic and normative implications, it is still firmly anchored to a modernist approach, and for good reasons.

Bio: Member of the Steering Committee of IRIS (Interdisciplinary Research Institute on Sustainability) based at the University of Torino (www.iris.unito.it). Her interdisciplinary research deals with epistemological issues arising in the framework of art, science and sustainability. Her PhD dissertation is based on an epistemological and normative analysis of the dominant imaginaries of science and technology, through artistic and scientific practices, in the framework of post-normal science. In parallel, her artistic research revolves around the use of photography as a participatory tool to raise the awareness in the scenario of sustainability.

>>Mae-Wan Ho, Institute of Science in Society, www.i-sis.org.uk

Why Beauty is Truth & Truth Beauty And Why it is Important for a Science Activist

Abstract: Scientists, especially the greatest scientists are motivated by the beauty of the natural order of things. So intensely felt is the love for the beauty of a scientific theory that some scientists are unconcerned as to whether the theory happens to be true. Fortunately, really beautiful theories tend to be true, in the sense that their predictions can be tested and confirmed empirically. That's what Indian-born American astrophysicist Subrahmanyan Chandrasekhar (1910-1995), recipient of the 1983 Nobel Prize for his work on the evolution of stars, argued in his book *Truth and Beauty, Aesthetics and Motivation in Science* published 1987. As a scientist who loves both science and art, who finds herself deeply involved in reclaiming science for the public good, I am certainly no stranger to the beauty of science and art. But is beauty truth, and truth beauty, as pronounced by the English Romantic poet John Keats in the enigmatic last lines of his poem "Ode on a Grecian Urn"? Are artists motivated by the quest for beauty and truth? What would "truth" mean in art? Or is the quest for beauty and truth in both science and art no longer relevant in the present day, having been overtaken by the profit imperative. Arthur Danto, Emeritus Professor of Philosophy at Columbia University and art critic remarks: "A century ago, beauty was almost unanimously considered the supreme purpose of art and even synonymous with artistic excellence. Yet today beauty has come to be viewed as an aesthetic crime. Artists are now chastised by critics if their works seem to aim at beauty."

Danto said that the modernists were right to exclude beauty from art, but also that beauty is essential to human life, and need not always be excluded from art. I fear that Danto has a rather superficial concept of beauty. Aesthetic beauty in art and science has nothing to do with the superficial appearance of things; it is a transcendent quality more akin to the sublime.

If beauty (and truth) is essential for human life, then beauty and truth are central to art and science, and recovering them is the most urgent task facing humanity as corporate manipulation of truth and beauty threatens the survival of people and planet. That's the project we have taken on at the Institute of Science in Society (ISIS).

In my talk, I shall try to show from my own science (and art) why beauty is truth and truth beauty, and why that is important for reclaiming science (and art) for the public good.

Bio: Ph.D. She is Director and Founder of the Institute of Science in Society (www.i-sis.org.uk), and Editor-in-Chief and Art Director of its trend-setting quarterly magazine *Science in Society*. She is best known for pioneering work on the physics of organisms and sustainable systems and as a strong critic

of genetic modification. Regarded by some as “the most influential scientist alive today”, Mae-Wan advises national government and United Nations agencies on a range of issues from genetic modification to sustainable agriculture and renewable energies. She has more than 170 scientific publications, over 500 popular articles in the most diverse fields across all scientific disciplines, and more than a dozen books, including *The Rainbow and the Worm, the Physics of Organisms (*1993, 2nd ed.1998, reprinted 1999, 2001, 2003, 2005; 2006, 3rd ed, 2008).

ANNEX B

Summary of Squared Tables

SQ. TABLE 1::

Title: Interdisciplinarity and stakeholders´ participation in the co-production of knowledge. Towards a re-conceptualization.

Organised by: *Cecilia Hidalgo and Claudia E. Natenzon – Univ. of Buenos Aires, ARG*

Abstract: *Interdisciplinary research* to address complex societal problems with multiple dimensions, *inclusion of stakeholders* to reach social robustness, and *reflexivity* to monitor and intervene on the process of collective production of knowledge constitute hallmarks of contemporary scientific projects. As a consequence, interdisciplinary with stakeholders' participation (ID+SP) teams are becoming an emerging pattern for the organization of scientific and technological research. Integrative arrangements of scientific work are increasingly being promoted by funding agencies to avoid the dominant disciplinary fragmentation of the sciences. The widespread call for ''stakeholder'' involvement in scientific projects as full team members or peers in an extended community becomes frequent, as a way to take into account diversity of knowledge and values, and to enhance interaction with an increasingly engaged population.

Significant difficulties remain in turning cooperation —working together for individual ends— into ID co-production of knowledge—working together towards a common end. The obstacles that an ID team with stakeholder involvement must face are not just many but also diverse: achieving consensus on a common problem or topic for study, the "right" composition of the research team, language barriers, multi-sited research, data hierarchies, tension between applied and theoretical outcomes, varied academic incentives, publication requirements, disciplinary biases, competition and the "geopolitics" of knowledge, institutional and personality issues. And, last but not least, the lingering challenge of assessing ID + SP work. The lack of consensus on common criteria for assessment of results is often ranked as a major practical difficulty of this type of research.

Indeed, the challenge to agree on ways to measure the success in the fulfillment of collective goals constitutes a key issue where to observe how participants manage to rise above the boundaries of their disciplines or social standards to develop a real process of knowledge co-production. It is a main challenge because co-production involves a complete re-conceptualization of scientific problems that must take into account their political and governance constitutive aspects.

SQ. TABLE 2::

Title: Making a place for science in post-normal times

Organised by: *Sylvia Tognetti, USA*

Abstract: President Obama's much discussed pledge, "to restore science to its rightful place" rests on the assumption that it ever had a place to begin with. Normal science, in which problems are framed as merely technical ones, has also served as a blinder to social context and to value conflicts as well as to uncertainty. Although it has created the conveniences of modern life - at least for some - it has also enabled what are ultimately futile and delusional attempts to control natural systems that we are all a part of, and led to unintended consequences that define life in post-normal times. Post-Normal Science offers insight for addressing these unintended consequences. By necessity, this involves the extension of the peer-review process so as to better understand the context as well as to inform decision-making and engage stakeholders in the process. However, little has been said about the boundaries between peer review and extended peer-review. In the context of the climate wars, scientific issues around which there is little disagreement within the scientific community, are being contested from outside the scientific process, following the methods of parody. Facilitated by ICT this

"extension of the peer-review process" has raised questions of whether PNS is tailor-made for the denialist crowd because it speaks of science in negative terms (see: The Policy Lass blog: http://shewonk.wordpress.com/2011/02/05/pns-pretty-nonsensical-stuff/) or whether it has been hijacked altogether (see: Deep Climate blog: http://deepclimate.org/2011/02/07/post-normal-meltdown-in-lisbon-part-1/)
The focus of this *roundtable* will be a discussion of Extended peer review as a challenge of governance and creating new institutions for science that will be necessary to find our way to a new normal.

SQ. TABLE 3::

ICT: Democratisation of scientific knowledge or democratization of ignorance?

Organised by: *Ragnar Fjelland, Univ. of Bergen, NO*

Abstract: The Internet offers the average citizen access to a tremendous amount of information. Information that it earlier took days and weeks to obtain, can now be accessed with a few keystrokes, almost from anywhere in the world. This information is no longer only restricted to the small part of the population who have the privilege of being at a university, research institution or near a major library. At the same time the Internet offers new opportunities for two-way communication. The citizen needs not just be a passive consumer of knowledge, but an active participant as well. In this regard the Internet offers the material conditions for a democratization of scientific knowledge. However, as already Plato pointed out, all technological progress comes at a price. In his dialogue *Phaidros* he tells the myth about the Egyptian god Teuth, who among other things had invented the alphabet. Teuth describes the advantages of writing to the Egyptian king Thamus, and claims that it will improve the memory of the people of Egypt. Thamus disagrees, and argues that the effect of the invention will be the opposite of what Theuth claims: Relying too much on written language will impair memory. Therefore, Theuth has invented a technology of forgetfulness.
An impaired memory is probably the price most people are willing to pay for the advantages of written language. However, Plato's argument applies to all technology, including information technology. Neil Postman, in his book *Technopoly,* pointed this out twenty years ago. Here is one quotation from the book: “Information is dangerous when it has no place to go, when there is no theory to which it applies, no pattern in which it fits, when there is no higher purpose that it serves.” These dangers have more recently been pointed to by Nicholas Carr in his book, *The Shallows*. Put in oversimplified form his thesis is that when *Google* has scanned the last book, no one reads books any more. The “deep” knowledge that can only be conveyed by a book, will disappear, because the internet fundamentally changes the way we read: We tend to search, and retrieve fragmented knowledge. If we know what we are looking for, this is sometimes very useful. But if we lack the background knowledge, or the context, it is dangerous. Everybody knows that if, say, a student of philosophy with no background in mathematics takes a textbook of mathematics and just picks out and reproduces the equations, he does not know mathematics. But what about a student of mathematics who picks out a quotation from a philosopher and thinks he knows philosophy? In both cases the danger is that the reader becomes more ignorant, because he thinks he knows something, but does not really know what he does not know. The real danger is that we may forget what knowledge is.

SQ. TABLE 4::

Title: How to institutionalise a post-normal, citizen science?

Organised by*: György Pataki, ESSRC, HU*

Abstract: There is a lot of discussion on the principles of a post-normal, citizen, or Mode-2 science, and a participatory turn in science. However, much less attention has been paid to the institutional setting of the everyday operations of scientific activities. Important questions may and, probably,

should be raised with regard to the achievements of institutionalising the above ideals. Some questions to be discussed and experience to be shared and exchanged with scholars from different European countries:

- Does science policy reflect the needs for a post-normal approach?
- What changes have been achieved in academic life by institutionalising citizen science?
- How and to what extent do the everyday operations of universities and research institutes demonstrate the spreading of Mode-2 science?
- What institutional changes have been achieved through a participatory turn in science?
- Do major stakeholders, such as policy-makers, funding agencies, corporations, civil society organisations, and the public as such really want, or feel the need for, a post-normal approach to science?
- Who are responsible for institutionalising post-normal science?
- What are the best institutional practices of operationalising and operating citizen science?
- What can we learn from the experience of sciences shops and community-based research?
- What can we learn from the experience from the science café movement?
- Does a digital society provide a better institutional setting for a Mode-2 science? If yes, in what sense and in what respects?

SQ. TABLE 5::

Title: Science communication, Science Appropriation and Public Interaction with Science in a Digital Society

***Organised by**: Inês Crespo and Paula Curvelo – Joint Research Centre, European Commission*

Abstract: On a workshop that aims to discuss the challenges of "Science in a Digital Society", it is almost inevitable to think of "Science in a non Digital Society." We believe that this counterpoint is fundamental to the debate we intend to conduct in this round-table, serving as a reference point for the topics that we propose to discuss.

With this setting established (which implies some preparatory effort to recover the memories of a "non Digital Society") we may then start to explore how new technologies of digital communication are affecting science.

The impacts of Digital Society in Science tend to be ascribed to three different domains: i) Science production; ii) Science communication, and iii) Public appropriation of science and ways of interacting with it.

In spite of the close relation between the three domains, on this round-table we would like to centre the discussion within the last two, particularly by focusing the analysis around the following issues:

1. The Impacts of the Digital Society in Science Communication:
    - How is it that new technologies of digital communication affect the process of science communication?
    - In what way are those technologies altering the links between science and other human activities and modes of expressions, including literature, music, film, photography, painting, etc
    - Which are the actors involved in science communication, and what roles should they play?
2. The Impacts of the Digital Society in Public appropriation of science and ways of interacting with it:
    - The spread of scientific information via new technologies of digital communication (social networks, email, blogs, e-learning, etc.);

• The democratization of science and the creation of new publics (?) → might this led to the creation of new scientific issues (?)
• The way public is appropriating science and contributing to it → the science produced by "non scientists" (?)

SQ. TABLE 6::

Title: For citizen science to succeed do we need some engaged artists?
Organised by: *Tom Wakeford – Newcastle Univ., UK*
Abstract: Positivism threw up a impenetrable barrier between our concepts of scientific and artistic creativity for more a century. The digital revolution has now speeded up a process that had already gathered pace in the "do-it-yourself" culture and community arts movements. It has abolished the art world's rule-of-thumb that creativity arose from the capability of extraordinary gifted individuals, who worked in exceptional ways to produce great works. Instead, driven by the forces of crowd-sourcing and imaginative agency, it has forced concepts of artistic creativity more democratic and more developmental.
Mainstream science is languishing in an epistemological crisis.

- Who decides which truth claims are correct?
- What is the ethical approach to creating new knowledge?
- How should those outside the laboratory choose what big questions that are asked within it?

While acknowledging natural science is not art, it is time to take post-normal science and extended peer review to the next level. Scientific creativity needs to be viewed through the same lens as art. Artists reveal the world by creating an interaction with their audience. So do scientists. Artists can help scientists examine our motivational values. Jean-Paul Satrre advocated that all art be "engagé", which translates from the French as "committed". Satrre writes "The only really *committed* artist is he who, without refusing to take part in the combat, at least refuses to join the regular armies and remains a free lance". *Doesn't this equate to value of openness in science?*
Albert Camus saw an additional dimension to "engagé"- calling for artists to accept their responsibility "to act as witness" for the persecuted, who "need all those who can speak to communicate their silence and keep in touch with them". In the digital age we can take things further, making opportunities for people to speak for themselves.
Art in the digital age depends on a genuine exchange between artist and community such that the one is changed by the other. *Are not engaged art and citizen science closer than we thought?*
It might be easy to agree that the scientists-of-tomorrow should join with their fellow citizens in re-imagining what being a committed scientist in a democratic society should mean in the coming decades. It is no mistake, perhaps, that historians call Louis Pasteur the Artist of the Invisible World. *How do we persuade scientists that they need to supplement their myth of the individual discovering truth with a new myth of how creativity happens collectively*?

SQ. TABLE 7::
Title: Technoscience ethics, transitions and interrogations
Organised by: *Ana Aleman and Kjetil Rommetveit, Univ. of Bergen, NO*
Abstract: In this roundtable Ana and Kjetil will discuss aspects of the transition between science (normal science?) and technoscience. They will use materials from a project called Technolife (http://www.technolife.no), namely the 3 "visions" that arose from a online debate on biometrics:
Dobermanmacload: Biometrics will enable us to closely scrutinize individuals tagged for closer observation, and quickly identify the perpetrators of crimes. Using the data from biometric observations, we will also be able to analyse patterns of movement for criminal intent, and automatically more closely scrutinize those individuals. Let me repeat: a future sustainable high

technology society will bear little resemblence to the one we currently live in - in particular privacy concerns will be minimized, and concerns about protecting the group will be of overriding concern.
Singularity Utopia: There is nothing good about biometrics because biometrics are open to misuse. Biometrics is simply a tool of oppression, but the leaders of capitalism say biometrics is for our safety and it will speed up everyday processes. We are told these measures will help prevent terrorism but we often see laws designed to stop terrorists being applied to people how are engaging in lawful protest. Anti-terror laws are a way for corrupt governments to silence freedom of expression. Biometrics is the beginning of 1984, it will lead to thought-crime and other authoritarian methods of oppression.
MarkoK: Sustainability (which we all hopefully agree about) means that available resources are limited and must be allocated with great care and longterm plans. Biometric tech, as any other tech, has its potential cons but is theonly way to make sure that everyone really got their piece of the pie in a high tech society. And its not just about distribution but also of making sure that resources are not wasted in absurd ways. Dont you agree?

SQ. TABLE 8::

Title: What is the post-normal theory of transformation?

Organised by: ***Gregory Hill, Univ. of Portland, USA***

Abstract: What is the postnormal theory of transformation?

A tension exists in the postnormal science tradition between management, safety and precaution on the one hand and a goal-oriented, normative approach on the other; between a perspective of adaptive change and one of transformative change; between a focus on "extreme system uncertainties" and engagement with the "extreme system complexities" of "characteristic contradictions that drive a system to a crisis." (Ravetz, 2006).
In many western cultures there has been has been both an attempt to linearize/domesticate deeply nonlinear/wild systems (e.g. ecosystems) as well an unwitting creation of nonlinear/wild systems that we then manage with a linear/domesticating approach (e.g. financial systems). Both give rise to the 'feral future' (Ramirez, Ravetz 2011) possibility as unforeseen perturbations threaten to push systems over a threshold. **What should be our approach to the potential of such a critical transition? When does a threshold require a precautionary approach and when does a threshold present an opportunity for transformational change?** Was the global financial crisis a moment to "arrest unfolding possibilities" or an opportunity to strategize for a transformative change to a fundamentally different future?
Post-normal science is well known for its sophisticated approach to uncertainty and risk, an important component of the "post-normal science of precaution." **How do attitudes towards uncertainty and risk need to be framed in situations where transformative change is needed? What is the appropriate role for the extended peer community in such a transformative context and does that role go beyond evaluation of quality to include goal formation and planning for transformation?** As communities and societies find themselves in profoundly untenable situations, across scales from local to global, transformative change is needed. **Which "pathologies of the global industrial system" can be reformed through a precautionary approach and which need to be fundamentally transformed?**
Technologies and their intertwined institutions and social systems play varied and dynamic roles in this distinction between adaptive change and transformative change. The practice of 'decision making' and the technologies supporting that practice often impose unexamined frames that constrict decision spaces, precluding transformative change. **What technologies assist participants in envisioning plausible futures and strategizing for purposeful transformation by promoting a reflexive practice that questions norms and protocols?** Informal self-organizing "shadow networks"

connecting social actors inside and outside legitimized networks have played a crucial role in capturing opportunities at thresholds through rapid and open exploration and innovation. **What role does ICT have in facilitating shadow networks to connect dispersed nodes of expertise and network motivated social actors to prepare for transformation?** Typically, transformative change requires interaction across scales and across social and institutional boundaries. **Which uses of ICT facilitate communication across scales and organizational boundaries that is needed to propagate transformative innovation?**

SQ. TABLE 9::

Title: Climate science on the digital market square: the role of gossip

Organised by: *Werner Krauss, Helmholtz Zentrum Geesthacht, DE*

Abstract: Climate blogs played a significant role in recent years. They helped to establish a new interface between science, politics and the public. Even more so, they thoroughly challenged 'traditional research methods, hierarchical arrangements, funding lines, peer review processes and reputation management'. In doing so, they changed definitively the course of the climate debate and the ways in which anthropogenic climate change is perceived. The hockey stick debate, climategate or the recent discussions about the IPCC are examples of the influence of the blogosphere. Maybe the greatest achievement of the blogosphere is that it opened up the hermetic field of scientific expertise to discussion and dialog. The blogoshpere, with the proponents of anthropogenic climate change on the one side and their skeptical opponents on the other, established a new platform, which will change the way knowledge about relevant issues will be produced.

While there is no doubt about these achievements of the blogosphere, there is still little known about the culture of the blogosphere itself. While we learned a lot from science studies about science as an indeed social process and practice, we don't know too much about the culture of blogs. This roundtable is intended to approach this unknown terrain by focusing on the role of gossip.

In cultural anthropology, studying informal communication is key to the understanding of the everyday life of other cultures. Gossip on the market square, in the cafes or on the street are a substantial part of everyday life. As science studies have shown, the same is true for the subculture of science, where gossip and office grapevine is an integral part of the production of knowledge (even so it is made invisible in the final outcome). Informal communication serves to establish group formation, to ensure membership in a group, and to situate and promote one's own role in a group. Furthermore, gossip serves to manipulate cultural rules, to confirm friendships and rivalries, to establish networks, and to challenge power and authority. Thus, gossip also provides necessary information to initiate group formation, to include and exclude, and to start action. All of this is familiar to each of the climate bloggers, whatever side they are on.

This roundtable will focus on gossip in the climate blogoshpere in order to learn more about its culture. We will have a look at conversational styles, semantic strategies and discursive tactics, and we will not spare the backside of this digital form of communication: manipulating career patterns, character assassination, malicious gossip, ruining one's reputation etc. This is often done under the mask of anonymity, with the mobilization of anonymous followers, by stretching rules of netiquette etc.

In short, this roundtable will serve to collect and to discuss case studies by administrators of blogs, by commentators, followers and readers. On the basis of individual case studies will single out certain traits and lay a foundation for a more systematic analysis of the culture of the blogoshphere.

SQ. TABLE 10::

Title: Teacher practices and Science: does ICT matter?

Organised by: *Caroline Rizza, Joint research Centre, European Commission*

Abstract: In today's world, there is no doubt that we live in an information or knowledge society. Information and communication Technologies (ICTs) are at the core of the social, economic and cultural activities of every citizen. They play a crucial role in the knowledge economy. Their impact on society concerns both knowledge manipulation and knowledge creation processes.
In this context, educational institutions from primary to higher Education have a double challenge:
- Supporting pupils and students throughout their learning process to acquire the required digital competences ;
- Taking benefit from ICTs and implementing new teaching practices in new learning environments.
In the field of Science, ICTs offer various opportunities at all levels: popularization of scientific knowledge for pupils, virtual environments of work, virtual laboratories to conduct experiences for higher levels, sharing spaces, etc. At the European level, the Science Teaching in a Lifelong Learning Approach[1] (STELLA) gives an overview of all these new teaching opportunities in the field of Science.
It has been shown in the literature that, when considering ICT uses in education and its effective integration in teaching and learning practices, a huge difference exists between the operational and post-operational periods of projects mostly financed to support innovative teaching and learning practices: in the majority of cases ICT is not adopted as common practice by teachers following the experimental phase. It has also been underlined that the use of ICTs in Primary School, Secondary or Higher Education is mostly due to pioneer teachers who are "crazy about" ICTs. In light of this information, most of the national and institutional ICT policies have made a shift in their supportive approaches from the pioneers to the "normal" teachers that constitute the majority of the academic population of an educational institution.
Since the teaching and learning opportunities offered by ICTs and their impact on educational fields - and more specifically on science - do not have to be demonstrated any more, what are the main barriers and drivers when it comes to evaluating their actual implementation in the educational practices? To answer to this question it is necessary to adopt a three-dimensional approach, consisting of the national, institution and individual levels, and focusing respectively on their obstacles and barriers, drivers and enablers, as well as on their interconnections.
Through this analytical framework, the round table will adopt the teacher point of view discussing about their competences, practices, needs, opinions, when to comes to consider the "impact" of ICTs on their teaching practices. This specific approach will also allow the consideration of peripheral topics such as online teaching and learning resources, creative common licenses, teacher professional development, collaborative work, availability of institutional and national infrastructures, etc.

SQ. TABLE 11::

Title: Collaboration instead of competition and exclusivity: a new way of making science?

Organised by: *Gualter Barbas Baptista (CENSE, FCT-UNL) in collaboration of Professor Jose Luis Garcia (ICS-UL) and Patricia Dias da Silva (ICS-UL)*

Abstract: Contemporary scientific research is often developed under a competitive model, where new knowledge and innovation are preserved within the originating group through systems of closed licenses, author rights and patents. Furthermore, research is also based on exclusive access tools, including closed/corporate software and subscription-based journals. Funding possibilities are, to a large extent, based on the volume of publications in impacting journals, creating a closed circle of science rule-definition.
This model creates discrimination among science practitioners, according to their places of origin and the relative power/influence of their host institutions (which to a large extent defines the budget available for acquiring software and publications). Furthermore, this exclusive access halts

[1] http://www.stella-science.eu/index.php

innovation, by reducing the number of possible links and cooperation between individuals and institutions practicing science.
It also separates the society in two layers: academics, which have access to the practice of science; and non-academics (e.g. civil society organisations), which do also create knowledge and innovation, but which have hardly any access to science tools (software and journals) and resources (funding opportunities) provided to scientific research.
What can science and academia learn and benefit from the FOSS (Free and Open Source Software) movement, their models and strategies, which have revolutionized the IT world? Is it possible and desirable to build a free and open source science in the digital era, where the means to publish are cheaper, diverse and highly scalable? Would such a move improve the quality of science and bring it closer to the common citizen, reducing the gap between the elite academia and lay people? What are the difficulties expected to be faced by academics, their institutions, as well as other science practitioners?

SQ. TABLE 12::

Title: Scientific Publications, Extended Peer Reviews and Intellectual Property Rights

Organised by: *Michel Chiaramello, Joint Research Centre, European Commission*

Abstract: With the digital society and the digital citizen, opinions and judgement become also digital and accessible and ever prone to debate and argumentation. In this "squared table" we will be looking at the transformations that the digital and citizen is doing to fundamental activities of the scientific endeavour, such as publications' peer reviewing, intellectual property rights and the alike.

SQ. TABLE 13::

Title: The Subjective, Instinct, Dream in Science in a Digital Society

Organised by: *Andra Bors, RO*

Abstract: This conversation will focus on the issue of the scientific process, in which the human nature, and society largely intervene, turning it into a subjective one. The reality of melting divisions in all areas of knowledge, and inter-wined interests, but also the importance of envisioning something greater than the average are topics to be discussed. To start our conversation we will show some instances of creative states, moods, examples which lead to great discoveries, where objectivity cannot be claimed.
This topic challenges the argument that science is no longer strict and confined, but unlimited, and free. We argued that although previously science was seen the best exploration for truth, today even truth is perceived as something personal, and thus, subjective.
The questions to be discussed are:“ Which are the traditional definitions of science?” What has changed?”
Which were the divisions in science areas, and what clichés were attached to them?”; “Can dreams turn into scientific projects?”
Also, the issue of multiple intelligences is going to be developed, explaining how different areas of knowledge stand out for a while, making people focus on them, while others remain in the shadows, until rediscovered, and later on brought back into people’s attention.
Furthermore, the process of scientific discovery shall be discussed from the perspective of human abilities and traits, which leave a signifying mark on the final outcome. The mutual influence of science and cultures is shown through real life examples, in which everything follows the trend of change. Despite all well-known pretntions of objectivity, science is more instinct-driven, so that human nature leaves its print in a great deal, and in all stages of the scientific process.
The importance of intellectual freedom, innovation, and acceptance of different perspectives shall be illustrated and debated. In addition, scientific fields will be at first integrated into broad categories,

only to prove they expand to a lot more than some formal divisions like hard, or easy, serious, or loose, strict, or adaptable.
I would like to discuss with you questions like:

- What does society need nowadays? What areas of knowledge are fashionable?
- How did the old divisions between all areas of knowledge melt?
- What is interdisciplinary approach?
- What are multiple intelligences? Which categories can mix?
- Where do scientific discoveries start from?
- What human factors intervene in the process of creation/ discovery?
- What subjective factors intervene in revealing/ accepting the scientific truth?
- What makes science complex?
- How does technology interact with other scientific areas?

SQ. TABLE 14::

Title: Teaching Maths in Digital age

Organised by: *Collin Hannaford, UK*

Abstract: My proposal for a round-table discussion is a problem now being noticed in many young people growing up in the digital age: namely, that whilst they have learnt to respond remarkably quickly to visual stimuli, they have serious difficulties in understanding text and in articulating their own ideas. They have similar difficulties in relating to each other. There is increasing concern that many adolescents are exhibiting symptoms of addiction to media, even to virtual realities.
To provoke discussion, I would offer copies of the recently published EdNews article. It offers an explanation of the cause of this problem, especially in the context of mathematics teaching. It also describes an elementary cure. The cure not only greatly improves young people's understanding of mathematics, as it will in other discursive subjects. It also greatly strengthens their competence and confidence in developing and articulating their own ideas. The relevance to their professional development - and, of course, to democracy will be clear,
Following the EU Education Commission study that I co-directed in 1996-1998, this problem is now being addressed in Germany, where greater emphasis is being placed on developing literacy and articulacy through the discussion of mathematics in primary schools. I have just contributed a chapter on this theme to a new textbook to be published soon in the United States. I have also been asked to lead a workshop for the Qatar Education City conference in London in June.
The most fruitful outcome of the round-table discussion will be to propose an educational protocol to achieve a better balance of reactive and interpretative skills.

ANNEX C

Participants

Name	affiliation
Abdou Khouakhi	Faculty of Sciences – Rabat, MA
Ahmet Turkum	Kocaeli Provincial Dir. - Min. of Environment and Forestry, TK
Alba L'Astorina	IREA CNR, IT
Alessia Ghezzi	EC - Joint Research Centre
Alexandra Fonseca	Instituto Geográfico Português, PT
Alice Benessia	University of Torino - IRIS, IT
Ana Aleman Delgado	University of Bergen, NO
Ana Correia Mouthino	UMIC
Andra Ramona Bors	Independent Consultant, SK
Andrea Saltelli	EC - Joint Research Centre
Ângela Guimarães Pereira	EC - Joint Research Centre
Angela Liberatore	EC - DG RTD
Annibale Biggeri	ISPO Cancer Prevention and Research Inst., IT
Antonio Silvia	Independent consultant
Antonio Marques Rodrigues Coutinho	Independent consultant
Bozhidar Ivanov	INSTITUTE OF AGRICULTURAL ECONOMICS, BG
Bruna de Marchi	Cooperativa Epidemiologia e Prevenzione, IT
Camilla dell'Agnola	O Thiasos, IT
Caroline Rizza	EC - Joint Research Centre
Cecilia Hidalgo	University of Buenos Aires, ARG
Çonceicao Bettencourt	Ciencia Viva
Collin Hannaford	Inst. Of democracy from Mathematics, UK
Cristina Gouveia	YDREAMS, PT
Cynthia Selin	Arizona State University, USA
David Broster	EC - Joint Research Centre
David Osimo	Tech4i2, BE
David Waltner Toews	University of Guelph, CAN
Dolores Catelan	ISPO Cancer Prevention and Research Inst., IT
Dorota Marciniak	UAB Barcelona
Elisa Rodrigues	Univ. of Évora, PT
Eshan Masood	Nature, UK
Fabiana Scapolo	EC-Joint Research Centre
Fatima Dias	British Council, PT
Francesca Ferri	O Thiasos, IT
Franco Accordino	EC - DG Information Society and Media
Gianluca Luraschi	EMSA, PT
Gilberto Gallopin	Independent Consultant, ARG
Giuseppe Munda	UNIVERSITAT AUTONOMA DE BARCELONA, ES
Gonçalo Lobo	New Univ. of Lisbon, PT
Gregory Hill	University of Portland, USA
Gretchen Gano	Arizona State Univ., ASU
Gualter Barbas Baptista	New Univ. of Lisbon and Ecobytes.net, PT
György Pataki	Corvinus University of Budapest, HU
Inês Crespo	EC-Joint Research Centre
Jelena Jovcic	Serbia

Jean-Paul Malingreau	EC - Joint Research Centre
Jean-Pierre Nordvik	EC - Joint Research Centre
Jeroen Van Der Sluijs	Utrecht Univ., NL
Jerome Ravetz	Institute for Science, Innovation and Society at the University of Oxford, UK
John Robinson	University of British Columbia, CAN
Jonatan Funtowicz	SKINACTIVES, USA
José Portela	IPVC-ESE, PT
José Vitor Malheiros	UMIC
Kjetil Rommetveit	Univ. of Bergen, NO
Lanka Horstink	NGO GAIA and Quercus, PT
Luciano Floridi	UNIV. OF HERTFORDSHIRE AND UNIV. OF OXFORD, UK
Luisa Biasâo Antunes	Independent consultant
Mae-Wan Ho	Inst. Of Science in Society, UK
Mario Giampietro	Universitat Autònoma de Barcelona, ES
Maria Alexandra Abreu Tina	Secret. Geral. Agricultura
Marta Agostinho	Inst. Med. Moleculare
Manuel De Oliveira	Independent consultant
Michel Chiaramello	EC - Joint Research Centre
Mihai Vomicescu	Univ. of Évora, PT
Paula Curvelo	EC - Joint Research Centre
Paulo Alexandre Rosa	CENSE, New Univ. of Lisbon, PT
Pedro Beça	CENSE, New Univ. of Lisbon, PT
Peters Saunders	Independent consultant
Philip Tattersall	University of Western Sydney, AUS
Ragnar Fjelland	University of Bergen, NO
Robin S. Smith	EC - Joint Research Centre
Rukiye Ozcivelek	Space Tech. Research Institute, TK
Sarah Davies	Arizona State Univ., USA
Serafin Corral Quintana	Univ. La Laguna, ES
Silvio Funtowicz	EC - Joint Research Centre
Sista Bramini	O Thiasos TeatroNatura, IT
Sofia Guedes Vaz	New Univ. of Lisbon and Foundation Calouste Gulbenkian, PT
Sylvia Tognetti	Independent consultant, USA
Thiago Henrique Santos	Lisbon University, PT
Tiago Pedrosa	Independent consultant, PT
Tom Børsen	University Copenhagen, DK
Tom Wakeford	Edinburgh University and Exeter University , UK
Valentina Turrini	O Thiasos, IT
Virgil Pamfil	Regional Centre for Continuing Training for Public Administration Bucharest, Romania
Viriato Soromenho Marques	Univ. of Lisbon and Foundation Calouste Gulbenkian, PT
Werner Krauss	Helmholtz Zentrum Geesthacht, DE

European Commission
EUR 25201 EN – Joint Research Centre – Institute for the Protection and Security of the Citizen

Title: **Science in a Digital Society**

Author: Ângela Guimarães Pereira

Luxembourg: Publications Office of the European Union

2012 – 40 pp. – 21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1831-9424

ISBN 978-92-79-23045-5

doi:10.2788/8471

Abstract

This report describes the main rational, objectives and outcomes of an institutional workshop - deliverable of the Action SIDSO (14099) for 2011 co- organised with the Anticipation at JRC Action and The Calouste Gulbenkian Foundation in Lisbon. The workshop explored in an anticipatory mode how current and emergent ICT will affect the conduct of scientific research in the future. Presentations and discussions focused on specific aspects related to emergent methods for engaging society and publics on scientific issues, new approaches for data sharing, mass computing, sharing of analytical tools, evaluating results and disseminating findings. Attention was also paid to impacts and security aspects associated with those approaches, namely related to scientific data and tools access, dissemination and deployment. The workshop recommended a number of fields where more thorough attention needs to be given

LB-NA-25201-EN-N

JRC Mission

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new methods, tools and standards, and sharing its know-how with the Member States, the scientific community and international partners.

Serving society
Stimulating innovation
Supporting legislation

Publications Office

ISBN 978-92-79-23045-5

doi:10.2788/8471