Heidrun Åm & Raffael Himmelsbach Session 1A

Norwegian University of Science and Technology

The affordances of a virtual centre in fostering RRI

In Norway, Responsible Research and Innovation (RRI) has become a central feature in the governance of emerging technosciences, such as ICT, biotechnology and nanotechnology. The Research Council of Norway (RCN) is a key driver in these developments. While the RCN's efforts to implement RRI in research governance has primary targeted individual research projects thus far, it recently began experimenting with integrating RRI as a constituent component into a new virtual centre for digital biotechnology – the Centre for Digital Life Norway (DLN). The RCN mandates that all research activities within DLN are to be underpinned by the principles of RRI. In this presentation, we discuss these ambitions and the challenges that arise when putting them into practice. We present a reflexive evaluation of two instruments of RRI implementation at the level of the DLN centre: a) the position and role of a RRI-coordinator, and b) the method of a search conference. Search conferences are classic tools of action research to stimulate real life large group learning processes and interventions. Both approaches start out *in situ* by addressing scientists' own concerns regarding responsibility and jointly elaborate how RRI can be shaped and implemented under the conditions they work in. The aim is to overcome scientists' resistances to RRI that have been reported in the literature when they encountered it as an external demand (e.g. van Hove and Wickson 2017; Felt 2017; Glerup, R Davies, and Horst 2017).

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María Belén Albornoz Session 6A

FLACSO Ecuador

Planning Innovation from the State: Policy Networks of Ecuador and Colombia

While both Ecuador and Colombia maintain a top-down policy type in the design of their public policies, the differences between these two countries as regards STI are quite significant. In order to explain the different policies at hand we use policy networks, which can show us how actors define themselves in direct relation to other groups of actors, what their capacities are, as well as their preferences and the structure of their relations.

This contribution explores how the actors' programmatic ideas are stabilized and how strategic learning is enhanced within the policy domain of science, technology and innovation. We compare the change in STI public policy of Colombia and Ecuador that began in 2006, the year during which a change of government took place in both countries, where innovation has been used as a go-to answer for policy change and a touchstone for governmental legitimacy.

Networks show the structure of the relations established by actors and institutions during the change of public policy, and this structure is fundamental to understand the programmatic ideas of the actors, their preferences and the negotiations of influence and domination that they exercise between each other. In both cases we took the change of government in 2006 as the policy window that allowed the STI policy change. In Ecuador this window contributed to the institutionalization of policy through the linear model, with new governmental entities and projects like Yachay City of Knowledge. In Colombia, this policy window helped to turn public policy towards productive innovation and the deepening of the triple helix through Law 1286.

Sally Atkinson Session 7C

University of Exeter

'The environment is our stakeholder': examining the green imperative in synthetic biology

Synthetic biology continues to be viewed as a promissory technology, with future-oriented potential to provide 'solutions' to a variety of complex concerns. For example, the environmental impact of existing modes of production, expanding needs and demand for industrial production and associated challenges of resource scarcity and security, are all areas that synthetic biology approaches claim to address. In this context, we examine and problematise the concept of 'environment' within a UK industry-academic bio-production collaboration. Based on an ethnographic study of responsible innovation in practice we analyse how competing narratives of 'environment' are mobilised and run through the discussions around the genetic modification of organisms for industrial biotechnology. Drawing on interview data and observation with a range industry and academic partners, we explore how the concept of 'environment' acts as a shared but diverse conceptual platform for industrial and academic narratives around the scientific, social, economic and political imperatives to enhance bioproduction through synthetic biology. We thus contribute to debates on the everyday enactment of promissory futures.

Martina Baumann & Daniel Frank Session 7B

Karlsruhe Institute of Technology

Ethical and societal issues of anticipatory machine learning applications

Machine learning (ML) is an emerging data driven technology with diverse applications from ad targeting and game playing to decision making in automated systems. Most of them contain an element of anticipating the future, some of them even aim at providing orientation on how to improve it. In this paper we want to propose an RRI approach to ML applications and use two (at first sight) quite different examples: Predictive medicine and Pay as you drive (PAYD).

For a long time it was assumed that the decoding of the human genome in 2001 will bring the treatment of all genetic diseases within reach. However, it soon turned out that little can be learned from the genome alone about the phenotype (of diseases). Also, having achieved major advances in genome editing techniques in the last five years (CRISPR/Cas9), we still don't know what to write. Thus, today, ML techniques are increasingly being used to model and predict the individual steps of the mechanisms of (genetic) diseases.

The other example is the car insurance model PAYD, which uses the increasing amounts of data generated in cars to calculate premiums, e.g. based on the driving style, and thus incentivise less risky behaviour of drivers. This example stems from a EU funded project on automated driving, VI-DAS (Vision Inspired Driver Assistance Systems), and allows us to make some remarks on the practical potentials and limits to influence technological development paths by the presented approach.

These examples are used to illustrate the approach applied to ML in different applications and to make clearer which ethical (and epistemological) issues are overarching issues and which ones are very specific. We will propose that 1) different sources of opacity of ML results should be distinguished as they are acceptable to a different degree and 2) just distribution of risks and benefits could be a suitable first leading principle for ethical analysis of ML applications.

Michael J. Bernstein & Fern Wickson Session 1A

GenØk Centre for Biosafety

Responsible research and innovation activities in investigator driven v.s. societal challenge research programmes of Horizon 2020: a first report from the NewHoRRIzon project

In this session, we report on our first year's results from the European Union's Horizon 2020 project entitled: "Excellence in science and innovation for Europe by adopting the concept of Responsible Research and Innovation." With the short title NewHoRRIzon, this coordination and support action seeks to advance the practice of responsible research and innovation (RRI) across European research funding programmes. At SNET 2017, we presented a range of tensions surfaced by the project, for example around, "how to maintain credibility and legitimacy while also holding an active normative position." Now through year one of the project, we will share an update on the participatory, problem-based approach we have been applying to our task.

NewHoRRIzon aspires to collaboratively design, implement, and evaluate pilot activities that support RRI in international and national research and innovation systems. We will present on a diagnosis of the current state of RRI designed to support this effort, as well as initial candidate interventions. Our presentation will draw from policy analysis and interviews to review challenges and governance mechanisms related to two different types of European Commission H2020 work programmes: one "investigator driven" (Future and Emerging Technologies (aka FET)), the other "societal challenge driven" (Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy (aka FOOD)). We will invite broader reflection about lessons from the RRI enterprise of H2020 as Framework Programme 9 is developed on the horizon.

Anne Blanchard Session 6B

University of Bergen

Death at intervals. Interrogating imaginaries of 'precision medicine' through fiction

In the modern 'war against cancer', precision medicine is a strong socio-technical imaginary. This precision promises patients more tailored cancer treatments adapted to their genetic makeup and tumour characteristics, with the ultimate goal of living extraordinarily long and healthy lives. Despite the high costs and the overwhelming complexity of cancer biology, this imaginary of precision medicine is very present in new and vocal networks of patients, medical institutions and pharmaceutical companies, together voicing their hope for and entitlement to 'a cure'. These imaginaries have become what Callahan (2003) calls the 'mirage of health': "a perfection that never comes [but which] is no longer taken to be a mirage, but solidly out there on the horizon". Imaginaries are soon to be taken for realities.

But it is important to critically examine this imaginary, and the many ethical, social and institutional implications should it become a reality; is precision medicine, or a world without cancer, actually desirable? In this paper, we argue that literary fiction may be a tool to help us interrogate this imaginary. As an example we will look at the 2005 book, 'Death at Intervals' by Nobel prize-winning author José Saramago. This allegorical novel presents a country where the personage of 'death' has stopped working, such that its citizens never die. This scenario creates absurd situations, revealing the implications of extreme longevity that we argue can stimulate critical reflection on the imaginary of precision medicine.

Marianne Boenink Session 5B

University of Twente

Anticipation of the future and responsibility taking in technology assessment and in medical prognostics

Awareness that new and emerging science and technologies come with many uncertainties has led to the development of a wide variety of approaches and methods to anticipate (and subsequently shape) how science and technologies may evolve and how they may impact society. It has also given rise to fundamental reflection and debate on what it means to anticipate the future, and whether for example responsible development of science and technologies requires anticipation at all (Grunwald 2014; Nordmann 2014).

In this presentation, I will argue that reflection on the role of prognostication in medical practice may help to further clarify what it means to anticipate the future, and how anticipation is linked to taking responsibility for the future. Throughout the ages physicians have tried not only to diagnose disease in individuals, but also to formulate grounded expectations as to how the patient's situation will evolve, with and without intervention. In recent years developments in molecular technologies and big data analysis have increased the number of tools available for medical prognostication, renewing attention for the meaning and role of 'prognostication' in medical practice.

Reflection on the evolution of medical prognostic practice shows that the meaning and role attributed to prognosis in medicine first of all depend on assumptions about the nature of disease and the possibilities to acquire knowledge about this disease (Christakis 1999). Whether or not physicians are optimistic about the possibilities to produce reliable knowledge, however, they are usually acutely aware that prognosis remains fraught with uncertainty. Nonetheless, they tend to assume some form of responsibility for prognosis and actual outcomes. Probing how physicians conceive of responsible prognostication in a context of uncertainty, and how this setting is similar to and differs from anticipating the impact of new and emerging technologies, can help elucidate what the meanings, possibilities and limitations of anticipation and responsibility in both contexts are. Moreover, it may also bring into relief considerations relevant for responsibly developing medical prognostic technologies.

Britte Bouchaut Session 1B

Technical University Delft

Risk and Safety Considerations from the Bioengineering Field

Because of rapid developments within the field of biotechnology, uncertainties rise with regard to their potential risks and how to assess and manage these. Based on these rising uncertainties, the process of policymaking needs to be modernised. Currently, people in the bioengineering field are considering incorporating concerns of safety explicitly throughout every step of the biotechnology innovation chain. This paper reflects on findings how different actors along this innovation chain perceive the concepts of 'risk', 'safety' and 'inherent safety' in the field of emerging biotechnologies for industrial applications.

Concepts addressed in this paper are unravelled and analysed by means of a literature review and in-depth interviews with stakeholders from the field of industrially applied biotechnologies. These stakeholders consist, amongst others, of experts in the field of risk assessment and management, actors related to two projects that are currently being executed in the bioengineering field, and governmental actors. By means of these analyses, perceptions and interpretations of these safety concepts within the literature and in practice can become clear. This will reveal if, and to what extent these perceptions align with each other. Obtained knowledge will lead to better insight in the different interpretations of safety, risks and the distribution of accompanying responsibilities among stakeholders, enabling identification of bottlenecks in the field of governance for biotechnologies, leading to better management of possible risks.

Scott Bremer Session 6A

University of Bergen

Sharing climate science products in a climate knowledge economy: a study of local communities in northeast Bangladesh

The past fifteen years have seen an increasing influence of climate science technologies and products on the ways publics understand and anticipate their relationship to weather and climate (Jasanoff 2010). We are witnessing a drive to develop more useable forms of climate science products, sometimes discussed as 'climate services', tailored to the needs of specific user groups. This drive appeals to a market heuristic, seeking to reconcile society's demand for climate information with the supply of climate science (Sarewitz & Pielke 2007), through 'co--production' between producers and users (Lemos & Morehouse 2005).

We argue that there are limits to this two--dimensional market heuristic, and that science products will be better integrated into publics' understanding of climate where there is a more nuanced consideration for society's 'climate knowledge economy'. Here economy refers to the system by which weather and climate information moves among people in society. Mapping this economy means understanding the diverse weather information possessed by people in different institutions, why some information is more trustworthy in certain settings, how information is communicated among people, and which scientific questions are most important.

This paper presents empirical research from the TRACKS project, mapping the climate knowledge economy in communities in northeast Bangladesh as a prerequisite to creating and sharing meaningful and trustworthy science products for local climate adaptation. This mapping was conducted through narrative interviews with almost 240 diverse actors in two communities in Sylhet Division, and reveals a surprising picture of how people choose to know their changing local climate.

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Maurice Brennan Session 2C

University of Birmingham

Risk, Regulation and Responsible Innovation of Nanomaterials: Developing an Adaptive Risk Governance Framework

Demonstrably, we are still unable to provide a confident answer to the fundamental question," are nanomaterials safe". This then poses the question whether the current European Union (EU) risk governance policy and regulatory frameworks with their technocratic focus are fit for purpose. The ambition within the EU is to realise the full benefits of the nano revolution, albeit with more desirable futures, set within a policy momentum which places Responsible Research and Innovation (RRI) and Safety by Design(SbD) at the heart of the innovation process. This presentation challenges to what extent EU risk governance strategies, policies, and instruments have impacted in achieving the strategic goal for the safe and responsible development of nanomaterials. Results are presented from a qualitative research study performed to evaluate cross-sectoral expert assessments on the progression towards achieving the above strategic goal and the key objectives set out in the European Commission(EC) Nanomaterials Risk Governance Strategies first published in 2004. The main findings identify that nanomaterials currently overflow their regulatory boundaries due to the lack of nano specificity in the EU horizontal chemical safety regulations and testing protocols. That whilst there is cross-sectoral recognition of RRI, its interpretive flexibility has meant its inconsistently adopted within the innovation space with a lack of industry engagement. Consequently, the EC strategic goal and objectives have not been met. But there are sign-postings that emergent scientific risk assessment protocols can offer the nano-specificity to underpin regulatory testing regimes. Additionally, the EC promotion of SbD within future nano-innovation processes could operationalize RRI within a model of Adaptive Risk Governance for nanomaterials.

Darryl Cressman Session 3C

Maastricht University.

Disruptive Innovation: Making Sense of a Contested Concept

Disruptive innovation has captured the contemporary technological imagination. From its obscure origins in management theory, it has become one of the concepts used to envision a future in which networked digital technologies and platforms are endowed with the capability to transform what are seen as anachronistic and inefficient industries and institutions.

The semantic expansion of disruptive innovation has resulted in a concept that has seemingly unlimited applicability. Disruptive innovation strongly resonates with a number of different sociotechnical futures while still maintaining an ambiguity, or ambivalence, towards any particular one. Besides being a useful policy tool for neoliberal proponents of deregulation and market expansion, disruptive innovation is aligned with the promotion of circular economies while also being invoked by critical social theorists who use it to predict the future of automation, labour, and the emergence of a post-capitalist political economy.

In order to gain some conceptual clarity, in this presentation I attempt to identify some of the crucial differences that are beginning to emerge within the expanding semantic field of disruptive innovation. Specifically, I am interested in examining how individuals are defined as either consumers, workers, or citizens across different disruptive scenarios and policies. These are ideal types, to be sure, but organizing the concept of disruptive innovation through these categories allows one to begin making sense of a concept that has thus far evaded careful attention despite its influence across a number of sociotechnical initiatives and policies.

Martin Cunneen & Martin Mullins Session 1C

University of Limerick

Artificial Intelligence Technologies and Decision Disorientation: Why Ontology Matters for Anticipating the Societal, Ethical and Legal Impacts of Artificial Intelligence Products

The role ontology can play in the interrogation of AI decision-making systems is relatively unexplored. We posit the case that developing an explicitly ontological approach can offer greater clarity in the field of AI decision making. From autonomous vehicles to high-frequency trading platforms, there now appears to be no limits to the potential applications of AI technologies. AI products will consist of numerous different decision types, executed through numerous different devices in numerous different environments, and in relation to numerous different agents. This diversity of machine decisions, actor and agents relations, as well as environmental variables, constitute a complex dynamic ontology of relations and dis-relations for AI decisions. Accordingly, we claim that in the context of emerging AI products and especially embodied products such as autonomous vehicles, and healthbots, there is a knowledge gap in relation to the spectrum of decisions that such embodied AI devices will carry out. This is an emotive issue, given that the decisions are socially observable, relate to human welfare and could if inaccurate, have adverse effects on human life. Therefore, we claim that the knowledge gap in relation to the decision capacity of embodied AI products needs to be ontologically investigated in order to understand better the variances in the relationships between intelligence and decision capacity in terms of anticipating societal, ethical and legal impacts.

Ana Maria Delgado

University of Oslo

From reproducibility to reusability: building an open infrastructure for biology

In this talk, I report on my research on digital infrastructures in biology, and in particular, on my work with the SBOL (Synthetic Biology Open Language) developers community. Drawing on interviews and digital ethnography materials, I show how the in the SBOL community software developers developed a concern with the problem of reproducibility in synthetic biology and tried to tackle it. In order to do so, they engaged in the making of a standard and open infrastructure for synthetic biology: SBOL. Yet, by engaging in this work of infrastructuring, the problem was reformulated and the concern moved from making synthetic biology research reproducible to making it reusable. I use the concept of 'moral economy' as defined by Lorrain Daston, in order to make sense of such transition.

Luciano d'Andrea Session 2B

Knowledge and Innovation. Rome, Italy

Anticipation as social process: Scanning society for grasping the future

This paper is intended to address the issue of anticipation in the context of science and technology by leveraging on outputs emerging from the EC-funded FIT4RRI project and two previous research projects on energy transition. The paper is organized in three main parts. The first part provides a short analysis of the reasons the growing demand for anticipation to regulate many aspects of social life. To this end, the strong connection between the increasing need for anticipating the future and the shift from modern to "post-modern" society will be deepened. In the second part, a critical analysis of anticipation as interpreted and applied in the governance of science and innovation will be conducted. In particular, starting from a reflection on the adoption of Responsible Research and Innovation (RRI) as the major EC policy framework for research, the usefulness and reliability of prescriptive and policy-oriented approaches to anticipation, and the need to go beyond them are discussed. In a different perspective, the third part explores the possibility of understanding anticipation as a social process, i.e., the possibility to identify "anticipatory dynamics" in the real world, where new standards, social configurations and cultural patterns connected to the development of advanced technologies and cutting-edge research are emerging and consolidating to an extent that makes it likely for them to become usual or even dominant. In this regard, some examples concerning energy transition will be presented. Some final considerations about the possible use of anticipatory social research and policy making will be proposed.

Conor Douglas Session 5B

Maastricht University

How might coverage decision-makers respond to future challenges and uncertainties related to drugs for rare diseases? Findings from a Canadian scenario study

As our understanding of diseases and how to treat them evolves, so too must our decision-making procedures for providing treatments for those living with illness. Today, one area of policy that lags behind is that for treatments of rare diseases. Often the cost of drugs for rare disease (DRDs) are very high resulting in a significant challenge for the health care system - in particular the pharmaceutical reimbursement plans. What is more, there is a relative dearth of evidence -and thus considerable uncertainty- regarding the benefits and harms of such treatments. This paper presentation reports on a scenario study geared towards helping drug coverage decision-makers in various Canadian provinces explore uncertain futures. Furthermore, those explorations are subsequently used to draft recommendations for sustainable, fair, transparent and future orientated policy for DRDs. Findings from this study stand to be of particular interest in Europe because in both Canadian and European contexts medicines are regulated by a centralized body (i.e. the supra-national European Medicines Agency or Health Canada), but coverage decisions are made at a decentralized level (i.e. by individual member-states or even regional healthcare providers, or in Canada's case individual provinces).

Clemens Driessen & Lauren Wagner Session 3B

Wageningen University & Maastricht University

Anybody home? A modest proposal for complete mobility

Recent trends in what is still labeled 'the sharing economy' are giving rise to a new mode of dwelling. In this presentation we will envision the impending world where everybody is mobile and we learn to leave behind the clutter of everyday existence. Critiques of Airbnb and associated transient forms of dwelling have so far focused on the effects on neighborhoods and increasing costs of living for those displaced from popular areas. But what has been left out of these debates is the draw of an emerging lifestyle that takes mobile dwelling to its logical next phase. We propose to appreciate the convergence of a number of sociotechnical scenarios: of growing mobility, shared dwelling, a move away from gathering consuming goods towards valuing experiences, the gig economy, and an overall increasing flexibility of life. These taken together make current problems of consumption, congestion and housing appear in a radically new light, allowing for a much-widened scope for transitions towards sustainable and attractive living. Living in free nomadic forms, aided by big data and algorithms, people-in-movement have now become more optimally governable than spatially fixed home owners. For both highly qualified as well as less skilled workers, residing in a fixed spot is no longer required, allowing nations to develop a globally competitive workforce, corporations to optimize labour and housing allocation and communities to organize themselves around lifestyles and personal interests. This presentation will discuss potential barriers this emerging sociotechnical future still faces and reflect on the possible role this imaginary could play to help us critically engage with the wonderful world of never-ending travel.

Claudia Egher

Maastricht University

Online Expert Mediators: A New Stakeholder or Problematizing The Role of Blogs In Patient Engagement

Digital technologies have often been hailed as conducive to patient engagement. Using Collins and Evans' concept of interactional expertise, this presentation examines the online activities of three bloggers diagnosed with bipolar disorder. It argues that by combining their lived experiences with medical knowledge, and by utilizing the affordances of blogs, they have become a new type of stakeholder - the online expert mediator. The bloggers were selected using the Google index as relevance indicator, and thematic analysis was performed on the data collected, including hyperlinks and images. Collins and Evans' concept is extended by considering the role of the medium through which interactional expertise is displayed and by showing that its bi-directional character is more substantial than they had envisaged.

The findings indicate that through the knowledge they display and the alliances they forge, these bloggers have successfully positioned themselves within a landscape characterized by increased individual involvement in health and have expanded their influence beyond that of most authors of illness blogs. The rise of this new stakeholder category denotes a possible turn from community activism to exceptional entrepreneurial selves. While blogs have been acknowledged as technologies with a democratizing potential, this new type of stakeholder acquires such high standing by developing close ties with 'traditional' experts. Rather than contributing to open science to more people lacking official credentials, online expert mediators might inadvertently contribute to the refinement of existing hierarchies between medical professionals and patients. This presentation thus provides a nuanced perspective on the level of authority and agency that people diagnosed can acquire through digital technologies.

Lucia Martinelli, Patrizia Famà, Paolo Cocco Session 5C

MUSE – Science museum. Trento, Italy

Engaging museum visitors in disorienting technologies: the case of human genome research

The new knowledge about human genome is growing and is already being applied in several fields, including healthcare. Markers for genes involved in important diseases are available to anticipate predispositions. Knowledge of our genome is easily available, as for instance in genetic tests offered at accessible prices on numerous websites. Moreover, important applications of "gene therapy" and "genome editing" are presented as unheralded opportunities. Genome technology, however, in its feature of anticipatory technology, is faced with new challenges, great opportunities and some risks, and bioethical, legal and economic problems have already arisen. They concern the capability to interpret the genetic information, its control, use and protection, the prevention of discrimination against people with some genetic predisposition, as well as management of uncertainty and anxiety likely associated with critical genetic information. Particularly in regard to health, the increasing possibility of knowing our genetic predispositions offers several advantages but also choices that can be difficult. In its mission of agora, i.e. a central meeting point where all can engage in science innovations, learn and share expertise on major conceptual advances in the life sciences with specific attention to ethical and social topics and to current issues, MUSE, the science museum of Trento, realized the temporary exhibit "The Human Genome. What makes us unique". In this presentation we show our approach aimed at offering to our publics the scientific tools to cope with the disorientation resulting from today's genome research. Drawbacks and solutions for engaging visitors in a challenging exhibit are discussed.

Steven Flipse Session 1B

Delft University of Technology

Developing incentives for responsible research and innovation in the field of automated vehicle development

This paper discusses the innovation landscape of automated vehicles in light of the notion of responsible research and innovation (RRI). Over the past years, RRI concepts have been formalized in research policy and project calls, following a growing societal and policy demand for more RRI practices. Still, while in some criteria for RRI practices have been identified, how these can be translated to innovation development practices is still up for discussion. E.g., how to explicitly adopt the AREA (anticipate, reflect, engage, act) framework would require both possible actions and incentives to act, boty in academia and industry.

In this paper the field of automated vehicle innovation is projected against criteria for both RRI and irresponsible innovation, to see to what extent this field can be called 'responsible'. We demonstrate that on most of these criteria, it is very hard to determine how RRI is taking shape around automated vehicle technology development. We consider potential incentives and barriers for the inclusion of RRI in the automated vehicle sector, based on two case studies in industry. This may support finding a balance between societal, technological and economic risks and benefits regarding the introduction of automated vehicle innovation in a responsible manner. We hope that this also helps in making RRI practices more explicitly visible in this field, in the hope that future innovation related activities around automated vehicles can make full use of the potential of RRI concepts.

Aafke Fraaije, Frank Kupper, Wieke Betten & Anouk Heltzel Session 7D

Vrije Universiteit Amsterdam

The creative democracy; exploring the value of art for public engagement on emerging technologies

Emerging technologies such as nanotechnology, biotechnologies and genomic engineering are transforming the world as we know it, and they are doing so at high speed. Their social implications are characterized by high levels of uncertainty, in the sense that their developments and impacts are unpredictable, and ambiguity, in the sense that publics can have significantly different yet similarly legitimate perceptions of the same implications. Therefore emerging technologies ask for an inclusive and reflective public debate, in which citizens are not only involved as users or stakeholders, but as citizens, from a public value perspective.

Currently, public engagement practitioners are experimenting with speculative art, fiction and design (from hereon: art) as a form to trigger critical reflection and public deliberation. Indeed, art may have some intrinsic qualities that are essential to such critical reflection and public deliberation. First of all, art can trigger public values and feelings and bring them to the surface, where they can enrich public debate. This contrasts with traditional forms of public deliberation that focus on rational deliberation of alternatives. Second, art can trigger imagination and make new futures conceivable. This is crucial since the uncertainty of emerging technologies asks for flexible and anticipatory governance. Third, art can invite a broad range of co-existing interpretations. This is important because the ambiguity of emerging technologies asks for diverse and inclusive governance in which a plurality of perspectives is embraced. In these ways, art-based approaches to public engagement may contribute to what Dewey described as the creative democracy.

During an interactive workshop we would like to further explore with the audience why and how art can contribute to the creative democracy. We will host this session together with colleagues who have worked with art as a means to public engagement. In four small, parallel workshop groups, these experts will share how they have applied art for public engagement purposes, and with the participants will discuss questions like 'what is the value of art for public engagement' and 'how can art help to shape the creative democracy?'.

Daniela Fuchs, Anja Bauer & Alexandra Bogner Session 4C

Institute of Technology Assessment, Austrian Academy of Sciences

Critical voices in the light of RRI - Societal engagement as an anticipatory technique

Anticipation of desirable futures plays a major role in research and innovation since concepts such as Anticipatory Governance, participatory Technology Assessment (pTA) or – more recently – Responsible Research and Innovation (RRI) have explicitly promoted the openness and responsiveness of science and technology to wider societal values and expectations. As a result, stakeholders and citizens tend to get involved in these processes in an invited and rational way. However, more direct forms of engagement in the context of contested technologies (such as protests of concerned citizens and CSOs) seem to be at danger of becoming marginalized on one hand while being quietly incorporated or distorted on the other. Involving them under RRI seems to call for new strategies of involvement as critical CSOs often bring in opposing future visions, challenging narratives of linear progress. Can potentially critical viewpoints be integrated into other agendas without being diminished as proposed by RRI? What are suitable conditions to involve actor groups with clear positions and interests?

Drawing on empirical analysis from a recently completed EU project, we will discuss whether and how new actors emerging at the science-policy interface such as (critical) CSOs may contribute to challenging conditions of societal engagement in the way it is encouraged under RRI. We will show that in the sense of responsiveness and openness it is not enough simply to increase the number of invited actors at an earlier stage. Rather, responsible innovation should be flexible enough to deal with controversies, to take competing voices beyond official RRI events into account, and to enable re-framing of issues at stake. To constructively take up different forms of societal engagement helps further the debate on responsible innovation in a broader understanding.

Rick Hölsgens & Aline Reichow Session 3C

TU Dortmund University & German Federal Institute for Occupational Safety and Health

Social innovation research, an emerging scientific discipline?

This paper scrutinizes 'social innovation' as an emerging field of study and asks whether social innovation research indeed develops into a new scientific discipline? Social innovation is emerging as a popular research topic – possibly even marking a paradigm shift in the practice as well as study of innovation. To some, the high expectations regarding social innovation even put technological innovation offside: what we need, it may be argued, is not a technology-fix (which could be offset by rebound effects) but changing social practices. However, the usage of the concept of social innovation goes all over the place. One may therefore conclude that 'social innovation' has developed into a (meaningless?) buzz-word. Many authors who have engaged themselves with social innovation over the last years have firstly – and rightly so – focused on defining its meaning. This has resulted in diverging definitions, but also in the (still ongoing) formation of a number of 'clusters' of social innovation research. We can observe that there is a lot of 'interpretative flexibility' within the understanding and application of social innovation and given the widespread normative implications and expectations, this makes perfect sense. However, as Weber and Truffer (2017, p. 106) observed in their review of Innovation Systems research, also for social innovation it holds that "this success in policy terms came at the price of limited academic rigour and, as a result, of a certain degree of fuzziness of some of the key concepts."

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Sylvester A. Johnson Session 4C

Virginia Tech

Machine Morality: Ethical Agency and the Future of Governance

Algorithmic ethics—software programs designed to weigh multiple inputs to reach decisions— constitutes a pivotal technological growth area that aims to humanize intelligent machine by structuring algorithms to make moral decision. This would seem to indicate that ethical algorithms are ethical agents. But can morality truly become a capacity of machines? And would this mean that machines should be recognized as moral agents?

   The applications that demand such capabilities are numerous and, in all likelihood, will increase as machine learning continues to expand. Fully autonomous vehicles require that the car make a splitsecond decision about how to mitigate property destruction and human death and injury in the case of an impending accident, as there is no time for a human to jump into the loop and intervene. Military technology is increasingly adapting machine behavior to approach autonomy. If this development continues, drones, missiles, submarines, and other forms of weaponized AI will need no human to make incremental decisions for warfare. Rather, machines will become capable of implementing attack strategies, detecting enemy vulnerabilities, and killing enemies with only a general command of objective from humans. In this scenario, war will proceed at a dizzying pace that forecloses on the practical utility of having a human in the loop. Other scenarios abound, from healthcare to law enforcement to environmental policy to the distribution of material goods. The sheer practicality and market-demand of machine-based decisions mean that algorithmic ethics is poised to become a central feature of the human future.

   This paper will examine the current research and development of machine moral agents. I draw on two scenarios—the current use of algorithms in criminal sentencing and the emerging capability of weaponized AI to target and kill a strategic enemy in the theatre of war. After explaining the informational architecture enabling this capacity, I examine theoretical studies of agency reaching from Ibn Rushd's interpretation of the intellect to recent studies of neurophysiology and machinelearning. I will foreground the case of brain-to-computer-interface (BCI) research to argue that closed-loop BCI applications constitute a compelling demonstration that the agential recognition applied to biological humans cannot be reasonably and principally denied to ethical algorithms. I will end by cautioning that the ethics of machines is no less problematic and contradictory as human ethics. The further implication here is that less attention needs to be devoted to supporting human exceptionalism and that more urgent work is needed to develop comprehensive systems of equity and justice employing human, machine, and hybrid architectures and social institutions.

Frederick Klaessig Session 2C

Pennsylvania Bio Nano Systems, LLC

Parens Patriae and Scientists in the Regulatory Penumbra

The innovation narrative, at least for the chemical, drug and biotechnology sectors, begins with a creative concept that through promissory claims attracts sufficient funding levels to survive later setbacks and misdirections: customer trials; regulators; vested interests; competitors; and societal & marketplace actors. While a new technology's plausible ramifications are difficult to anticipate, there is relative stability regarding those scientists and their disciplines that are within the regulatory penumbra: regulators; the regulated community; advisory panel experts; contract research organizations; and engaged NGOs. Learning the details of a new technology will challenge each, but their responses will reflect a facility with the regulatory framework, its statutory basis and its administrative procedures.

The literature on responsible research and innovation rarely addresses the scientists participating in regulatory decisions despite these colleagues having very similar technical backgrounds to those pursuing the innovation. Tools of the trade, normally considered epistemically acceptable, lose credibility when scrutinized in a normative-based validation scheme; the journal article is no longer considered evidence; and open science intertwines with confidential information. Scientists' perceptions of the technology and its societal impacts come to reflect their respective locations along the innovation trajectory, one that runs from the promissory claims, which for emerging technologies is frequently the government-as-funder, to the protective claims of government-as-parens-patriae, the parent of the nation.

The perimeter of the regulatory penumbra will be examined using examples from the recently completed EU-US NanoInformatics Roadmap 2030, in particular. the role of QSAR models in introducing newer scientific concepts and testing techniques into the existing regulatory framework. Distinctions will be drawn regarding U.S. regulators and scientific renewal.

Zahar Koretsky Session 7A

Maastricht University

Terminating technology: a literature review

Technological innovation is typically seen as something that adds, grows, provides value, destroys old and replaces it with new. While most attention is given to attempts to foster new technologies, the phenomenon of technology fading away is important as well. Sometimes the termination of technologies has been intentional, as was in the cases of technologies that have been banned in the past for reasons of 'responsibility', such as chemical weapons, DDT, carbon tetrachloride, gene modification, or, more recently, incandescent lighting. Terminating technology clearly is a process of active resistance and counter-resistance, with complex dynamics and multifaceted societal effects.

In this paper I review findings, concepts and theories from various disciplines studying the histories of deliberately terminating technologies. Discussions of terminating technologies under different labels (e.g. discontinuation, uninvention, destabilisation) can be found primarily in innovation studies and STS, but also in policy and organisational studies. The review confirms that the complex phenomenon of termination of technologies has not been the focus of nearly as much scientific scrutiny as creation. I will highlight the theories of uninvention, of socio-technical transitions and of governance of discontinuation, which differ in their take on the character of termination (intentional and non-intentional), the agent(s) involved (coordinating and non-coordinating) and the focus (governance process and technology). I will conclude the paper with a discussion on whether and how technology can be "removed" from society, for reasons of responsibility or otherwise, and what happens when this is attempted.

Heidrun Åm (Session 1A)**, Anne Loeber** (Session 3B) **& Lotte Krabbenborg** (Session 3B)

Norwegian University of Science and Technology, University of Amsterdam & Radboud University

Panel proposal: Collective deliberation and negotiation on emerging technosciences: what does it entail?

There is an increasing academic and policy interest to involve civil society actors, both individual citizens and civil society organizations, as new dialogue partners of science, industry and policy in the development and uptake of newly emerging sciences and technologies like nanotechnology, synthetic biology and new genetic sequencing technologies (Swierstra & Rip, 2007; Von Schomberg 2013; Krabbenborg 2016). Having more and better societal deliberation on NEST is expected to increase societal acceptance, as potential societal concerns and needs can be voiced in an earlier stage and anticipated upon in decision making processes.

However, by putting the spotlight on civil society actors, researchers, or so-called stakeholders, the socio-technical grounds on which such societal deliberation is demanded remain backgrounded. Indeed, social studies of emerging technosciences seem to miss out on the socio-political-economic conditions that influence initiatives to democratize science and technology by fostering more and better societal deliberation when they merely focus on individual research projects, particular technologies, or single case studies. In a time in which Western liberal democracies show signs of decay (as obvious in low voter turnouts, the weakening of critical institutions, and post-truths discourses), but as well in a time in which capitalism and new public management permeate all spheres of R&D: what do calls for collective responsibility and creating a better common future (Owen et al. 2013) link to? In a fragmented society, who is included in the 'we' that shall decide on making technoscientific futures?

Therefore, in this panel we would like to discuss which broader transitions are necessary in order for a democratic governance on emerging technologies to catch on. What does societal deliberation, or becoming more responsive to societal issues and needs, entail for new roles, responsibilities and collaborations between scientists, industrialists, civil society and policymakers for example? And how can we move the recent policy initiative to create 'responsible research and innovation' (RRI) from its project orientation to a more collective level?

Heidrun Åm's (Norwegian University of Science and Technology) presentation will depart from two biotechnological research projects on new feed for farmed salmon. According to the RRI-framework of the Norwegian Research Council, scientists are supposed to conduct these projects according to RRI-dimensions. Åm will map the governance landscapes around salmon farming and actor networks that such projects are part. Who is in charge of choice and change? Where do RRI-activities in individual biotechnology project fit into this picture? Based on situational analysis, her intention is to elicit the democratic situations of these biotechnology endeavors.

Anne Loeber (University of Amsterdam) will discuss the leverage power exerted by science funding schemes, and the limits thereof, in promoting the uptake of RRI in scientific practice. Taking the experiences with organizing a so-called Social Lab on RRI in Horizon2020's MSCA

('Marie Curie') excellent science program line as a point of departure, the paper will reflect on how requirements in research funding may help develop 'projective grammars' (Mische, 2014) for individual research projects and as such help 'produce' the imagined publics that play such a central role in the conceptualization of the RRI-notion.

Lotte Krabbenborg (Radboud University) will argue that an active public sphere, i.e. the open space in a democratic society supported through a diffuse media infrastructure, is a background requirement to more productive interaction between technology developers and civil society actors on emerging technologies. She will show that in order to have NEST as topic for deliberation in the public sphere, new competencies have to be developed at the side of technology developers, but also at the side of publics.

Alexandra Hausstein & Andreas Lösch Session 7A

Karlsruhe Institute of Technology

Multiple visions and their quest for future – clashes, repercussion, adaptation in politicized futures.

Science and Technology Studies on sociotechnical futures (such as visions, imaginaries and expectations) often assume, that innovations and sociotechnical changes are influenced by one stabilized, dominant and successful vision of a future. This is often a strategy that reconstructive studies use, in order to tell a consistent story line on the roles of futuristic visions and imaginaries, showing how a variety of actor expectations converge in commonly shaped visions or imaginaries, and constructing correlations with specific trends and results of such processes. We will argue, that such correlations can be better explained, if one focusses analytically on the "socio-epistemic practices" where diverse visions of futures enable re-configurations and new configurations of the orders of knowledge and simultaneously of the sociotechnical arrangements. (http://www.itas.kit.edu/english/projects_loes14_luv.php). Thus, we would like to propose an approach, where we analyze the emergence of dominant futures and the related processes of their construction and re-construction in different settings, by diverse actors. That means that we conceive clashes of competing futures as being constitutive for successful futures, but not just in the sense, that one future (e.g. imaginary, narrative) replaces or eliminates alternative futures. Our paper will concentrate on the question, how competing futures interact with each other, resulting in processes of successfully assembling, appropriating, hybridizing, recombining and integrating certain elements of competing futures. Our paper presents and discusses conceptual reflections on this issue and will illustrate them by spotlights on such productive clashes in different cases (e.g., nanotechnology, digitized energy grids, urban mobility).

Maria Maia, Christopher Coenen & Karsten Bolz Session 4B

Karlsruhe Institute of Technology

Session proposal: Understanding and Addressing the Challenges of RRI in Industry

While the concept of Responsible Research and Innovation (RRI) has become increasingly important and debated among science and innovation policy experts, in publicly funded research projects and by a variety of societal groups, its application in industry settings is still unclear. On the one hand, the EC has financed several projects aimed at providing input and establishing a roadmap to foster the implementation of RRI in industry. On the other hand, industry has argued that RRI fails to have impact in the industrial community due to the misalignment of concepts, tools and methodologies, which increases difficulties in the communication between both parties (industry and researchers).

For example, RRI aims to improve the alignment of research, technology and innovation with societal objectives and values. Thus, its implementation in product development cycles by industry might allow for the anticipation of potential negative consequences and a more effective management of the impacts of technologies by industry itself. To reach this goal, RRI emphasizes, inter alia, the importance of involving different stakeholders in innovation processes. However, it is unclear how such intense stakeholder engagement can be stimulated effectively in an industrial setting.

One possible way to overcome the obstacles to integrating RRI into business practices is to look for relevant connections to industrial approaches, such as Corporate Social Responsibility (CSR).

This session aims to address the challenges posed by the concept of RRI and its adoption in industry. Although the topic is not directly related to the strands identified by the call, the topic it addresses is of prime importance and may contribute to the current debate on the importance and benefits of RRI.

Some questions that will be addressed in the session are:

- How to integrate RRI into business practice?
- What is the added value of adopting RRI for companies?
- What are the opportunities of integrating RRI in industry and what are the risks?
- What are the costs/benefits for companies in becoming more "responsible"?
- How to implement practices for stakeholder engagement along the R&I value chain?
- Why are some companies still reluctant to adopt RRI?
- How can the value of RRI be measured and evaluated?

With four contributions, the session provides a unique opportunity to discuss and explore the introduction of RRI in industry.

Abstracts of the contributions are provided.

The organizers of the proposed session would welcome other contributions that the SNET committee considers suitable for inclusion in the topic discussion.

Contributions to the session:

Steven Flipse & Emad Yaghmaei

Experiences in trying to involve industry in RRI projects: really supporting RRI vs. just another socially desirable project?

With the growing number of (inter)national projects that aim to study and support responsible research and innovation in industrial contexts, the question rises how to best involve industrial partners in such projects. From experience, we can tell that involving industry is by no means an easy task. But the real difficulty starts when the project commences: how do we keep industrial partners interested over the course of these multi-year efforts? Based on our experience in coordinating and participating in multiple European public-private partnerships, we share our experiences in how to set up collaborations, and also share how we experienced such collaborations to develop in time, over the course of the projects.

Our experiences are mixed: involving industry requires a delicate balance between offering services and promising desirable outcomes, while also safeguarding the independent attitude that is needed within the university research context to allow for academically solid social scientific research in the field of responsible research and innovation management. One might over-promise the possible beneficial (economic, social and/or technical) outcomes, and that begs the question whether RRI is done for morally right reasons beyond (possibly morally right) economic reasons. We discuss to what extent that phenomenon in itself may or may not be desirable, and whether it is acceptable that RRI efforts concentrate in projects, rather than become embedded in the governance structures of organisations, in so far as possible.

Lotte Asveld

PRISMA: the Evolva case

Evolva seeks to provide synthetic alternatives for natural ingredients, that have "issues". Quoting their website about those issues: "The plant or animal that makes the ingredient is too rare, too hard to grow or does not make enough of it. Hence, the ingredient is not available at the right quality or price that allows most of us to benefit from it in a sustainable manner" (Evolva, n.d.-b). Through synthetic biology, Evolva hopes to remedy these issues. By combining genes from organisms that produce a certain rare ingredient and baker's yeast, it gives the baker's yeast the ability to produce these ingredients through brewing.

Evolva has experienced resistance from environmental organisations in the past with some of their innovations, such as synthetic Vanillin and synthetic Saffron. The company claims to be committed to Responsible Innovation, however so far this has not prevented resistance from other actors. A main point of critique is that with their products, Evolva undermines the livelihood of those making their living in the 'original' value chain of the product Evolva offers a synthetic alternative to, for instance the people that manage the natural vanilla orchid in the rainforest of Madagascar.

Leaving aside the issue of whether Evolva's innovations indeed have this effect, this paper will focus on the question whether Evolva (or any other company) is responsible for such possible economic effects of their innovation, considering the framework of Responsible Innovation. The main question addressed in this paper is therefore: Are companies responsible for possible negative effects their innovation has on vulnerable actors in existing, competing value chains?

Ibo van de Poel

As part of the PRISMA project, we are carrying out a pilot project on RRI in industry with a cleaning company. The company is a Dutch manufacturer of cleaning agents for professional use. They create private label products and develop innovative cleaning concepts like systems with smart dosing systems that contribute to more sustainable use of cleaning agents. The company sees itself as a pioneer in the area of sustainability.

The pilot focuses on a new version of the dosing system that the company is currently developing and which can exchange information about the use of the system via Internet with the company and its customers. In the future, the company wants to make more use of the Internet-of-Things (IoT). Collecting data about the cleaning behaviour of clients may in the long run not only help to improve service but also contribute to further product innovations that contribute to service, quality and sustainability. As a result, the company is slowly transforming from a manufacturer of cleaning agents to a manufacturer of cleaning technology. This step also requires taking into account of a broader range of ethical issues than sustainability.

We will present how the design for values approach helps the company to early detect possible ethical and responsibility issues with the new technology they are developing, as well as to address these issues proactively in the design of new dosing systems and the development of new business models. We will discuss relevant values like public hygiene, privacy, security, (professional) autonomy (of cleaning personnel), and trust. We will reveal potential tensions between these values as well as potential ways to address these value tensions.

Karsten Bolz, Christopher Coenen, Hadewych Honné, Maria Maia, Erik Schurer

Obstacles to RRI in Synthetic Biology

Discourse on synthetic biology is shaped to a large extent by the older discourse on green biotech which is strongly rigidified, with frozen lines of conflict and often a rather poisoned atmosphere. Companies engaged early on in synthetic biology for agricultural, food or similarly contested applications, nolens volens engaged in public and stakeholder engagement activities based on the concepts of responsible research and innovation (RRI) or responsible innovation. They partly came to the conclusion that such activities are either of little use, counterproductive o or not effectively practicable without an increase of personnel resources for such activities. Since the latter is, due to considerations within the companies, hardly feasible without support from outside, the case of companies using

synthetic biology for the above-mentioned applications can be used to analyse the preconditions of RRI with a view to the tension between notions of discourse inspired by Habermasian and Foucauldian thinking respectively. How do power relationships within and between the various stakeholder groups involved in the controversies about green synthetic biology impact on the chances to come to successful co-creation of innovation? What do the affected companies expect from publicly funded RRI support activities? Based on ex-post analyses of relevant stakeholder interactions and debates, including a comparison with other discourses, we will discuss the reservations among some companies and other players about certain approaches to RRI as well as structural problems impacting on RRI as a procedural innovation.

Ineke Malsch Session 6C

Malsch TechnoValuation

A 3D-approach towards Future Technologies We Want

The Rio+20 United Nations Conference on Sustainable Development concluded with the outcome document "The Future We Want", endorsed by the UN General Assembly in June 2012. Three years later, the UN General Assembly adopted the Sustainable Development Goals 2030, with special emphasis on the role of science and technology. How can governments and stakeholders cooperate in governing emerging technologies contributing to this common future? A 3-dimensional approach is proposed to international sustainable and responsible innovation, combining legal, technical and social fixes. Legal fixes may include international constitutional change, culminating in a global parliament and dual national and global citizenship, but also less revolutionary proposals. Technical fixes include value-sensitive design of technologies and products. Social fixes include public dialogue about norms and value-differences between cultural and religious communities. This approach forms the backbone of my new book Future Technologies We Want, where it is applied on three cases where technologies have positive, negative or uncertain consequences for sustainable development. The cases are conflicts over mining, biosecurity and drones. In the proposed oral presentation, the approach will be explained and its relevance to these cases discussed.

Ingeborg Meijer Session 2B

University Leiden

Assessment of Responsible Research and Innovation (RRI) – beyond indicator development

The idea of Responsible Research and Innovation (RRI), as currently promoted by the European Commission, aims to bring science and society closer together, stimulating productive mutual exchanges for the sake of both sides. Presented as open and transformative by the European Commission, it is contested and presented as rather vague by some scholars. And at the institutional level, the uptake of the RRI concept in their local policies is largely unclear. In order to bring more light into the evolution and the impacts of RRI, DG Research and Innovation commissioned a study led by the Technopolis Group (MoRRI – Monitoring the evolution and benefits of RRI) to investigate in detail the current status of the underlying concepts of RRI including its recent dimensions Public Engagement, Science Education / Science Literacy, Gender Equality, Open Access and Ethics. In this study a wide range of activivities has been carried out that need wider dissemination and debate on content, meaning as well as how to move forward. It contributes conceptual work on RRI, provides extensive exploration of existing metrics capturing RRI, and develops new indicators requiring primary data collection. Primary datacollection extends towards two large-scale surveys among European researchers about their views on the relevance, benefits, barriers and hindrances for RRI within their daily research activities; large surveys to Research Funding Organisations (RFO), Research Performing Organisations (RPO) and Research Institutes.

The MoRRI project elaborates on further conceptually defining what is (and what is not) RRI, in order to lay the foundations for a broad-based agreement for policy intervention; the keys and areas to be monitored; a selection and critical reflection of indicators across all dimensions and reflection on data collection and the cluster analysis of European countries. In addition, a series of case studies has enlightened potential different types of benefits of RRI (economic, scientific, democratic, social) and the framework conditions which promote or hinder their occurrence. Further experimentation at the organisational and researcher level, and further theoretical conceptualization of RRI and its dimensions will be discussed.

Lantz Fleming Miller Session 6B

University of Twente

The Promise of Infinity

The longstanding philosophical discussion about immortality or life after death has received a new boost in the prospect of immortality attained via technologies. The earlier discussions were concerned with whether humans come with an immortal aspect (soul). In the current rendition, humans generally are considered mortal, but they may develop means of making themselves immortal. If one considers that 'immortal" means not mortal, thus not ceasing to exist, and thus existing for infinity, a key quandary lacks sufficient attention: If the proposed infinite-existing entity is material, it must inhabit an infinite material universe. If the proposed entity is not material, there must be some means by which it can shed its material substance and exist non-materially. While some speculative physics may be claimed as a basis for allowing one of these two scenarios, such speculation seems inadequate basis on which to build an edifice of infinite existence. The article examines several arguments for how an infinite life would be possible given current physical understanding, and finds each argument problematic. In unweaving the apparent substantiality of these arguments, the paper considers a Pascalian wager weighing the likelihood of adjusting to existence wholly within a finite universe vs. betting on there being some way to construe the universe(s) as a viable medium for infinite beings. This paper's approach is more ontological and epistemological than normative, although normative interpretations may be apt here as well. The article concludes that the case for a finite being to exist infinitely has, in current physical understanding, little viable support.

Karen Dam Nielsen Session 4C

University of Twente

Anticipating Alzheimer's futures: the promise of biomarkers vs current ways and values of anticipation among patients and their informal carers

Emergent biomarkers for Alzheimer's disease (AD) aimed at early diagnosis and prognosis are, potentially, "anticipatory technologies" in that they are expected to provide clinicians, patients and their family with information about 'what is to come'. As such, biomarkers are aimed at filling a gap in current AD care where little or nothing can be said about how AD will progress for the individual. Still, or partly as a consequence of this gap, patients and their informal carers employ a number of strategies for relating to and managing the future: to foresee and prepare for it - and/or to bracket and park it. In this presentation, I unpack some of these strategies based on insights from a participatory RRI-study that in itself can be described as an anticipatory technology: exploring, shaping and sharing patients' and informal carers' expectations to emerging diagnostic and prognostic tools in AD. A few insights stand out as particularly relevant for the promise and possible implications of emergent AD biomarkers: the power and powerlessness of (getting) an AD diagnosis, the ambivalence towards knowing the future, and the multiple meanings and practices of preparing. Supporting a practice-based, value-oriented and constructive approach to technology assessment (e.g. Keulartz et al 2004; Kiran et al 2015; Boenink et al 2016), I discuss how these insights can be translated into (ethical) recommendations for AD biomarker research.

Susanne Oechsner Session 2A

University of Vienna

Making space for aging in place

Active and Assistive Living (AAL) technologies are ICT-based systems and services, which shall provide a technical solution to the problem of demographic aging by supporting older people to stay in their own apartment for as long as possible. Aging-in-place is a concept in which societal and individual needs are taken to be congruent; if older people can remain in their surroundings and do not have to move into care facilities, the strained social and health care systems will be able to save costs.

In this paper, I employ a spatial lens to AAL as sociotechnical infrastructure that supports aging-in-place. I will offer an analysis of the spaces that come into being through the deployment of AAL technologies and how they are imagined enabling future users' aging-in-place. By drawing on interviews with developers of AAL systems and on document analyses of project deliverables of AAL projects, I will show the establishment of active and safe spaces that are based on pattern recognition and (in)activity monitoring. These spaces are imagined to sense deviations from an embodied normality and to enable a (deep) understanding of the well-being of an individual, aggregated and represented in sensor data that then get to travel to other places in which they take on new meaning. I conclude this paper with a discussion of the limited understanding of well-being that is inscribed here.

Leslie Quitzow Session 7A

Leibniz Research Alliance on Energy Transitions. Wissenschaftszentrum Berlin für Sozialforschung, WZB

Imagining smart urban energy futures

Smart grid infrastructures combine the promise of clean energy transitions with that of high-tech development and economic growth, and are therefore currently at the top of urban policy and business agendas. Although only vaguely defined, smart grids broadly stand for the incorporation of information and communication technology (ICT) into electricity networks. Visions attached to the smart grid center around a variety of goals, most importantly cleaner and more efficient energy use, the combination of infrastructure sectors and more active consumer participation.

My case study of the imaginaries surrounding smart grid development in Berlin shows that here, the introduction of digitized electricity grids is carried by a vague but optimistic belief in the ability of digital innovation and economic opportunity to facilitate "smarter", "cleaner", more energy-efficient and climate-friendly cities. They are accompanied by a common notion of urgency, necessity and inevitability that largely derives from (or is framed as) a commitment to Germany's renewable energy targets and from a strong reliance on technological solutions to achieve these climate-related goals. Dominant narratives suggest that the digitization of electricity grids will enable urban energy futures that are more independent, sustainable, efficient, flexible, and participatory.

However, the production of these visions is largely confined to relatively small communities of experts, leaving little room for critical public debate. Alternative visions or competing narratives therefore hardly exist. Issues such as data protection, cyber crime, or platform ownership are largely neglected. Smart grid imaginaries therefore serve as common denominator for one-way communication to the public, rather than two-way communication with the public.

Alecia Radatz, Erik Fisher, Michiel Van Oudheusden, Harro van Lente & Christopher Coenen Session 4D

Arizona State University, KU Leuven, Maastricht University & Karlsruhe Institute of Technology

Session Proposal: Assessment of Engaged Social Science Research

S.NET began almost a decade ago, focusing primarily on the future social implications of nanotechnology. It is therefore appropriate to review in detail some of the work of this period.In this panel, four separate presentations provide assessments of four different nanotechnology and society research programs. Formal and informal assessment techniques were used to generate these reviews. The presentations discusses outcomes, strategies for technology assessment, engaged social science, and lessons learned, among other topics.

Note: This panel of full presentations will complement a more discussion based roundtable with a broader number of programs making comment: "Collaborative Histories-an STS community considers the Nano social science of the past 10 years."

Alecia Radatz & Erik Fisher

Arizona State University

Engaged Social Science Research in Nanoscale Science and Engineering Communities: An Assessment of the Center for Nanotechnology in Society at Arizona State University

Increased funding of U.S. nanotechnology research at the turn of the millennium was paired with a novel societal research policy and a legislative commitment to the responsible development of nanotechnology. Innovative policy discourses at the time suggested such work could engage a variety of publics, stakeholders, and research community actors in order to enhance the capacity of research systems to adapt and be responsive to societal values and concerns. The National Science Foundation allocated funding to support research, education, public outreach, and international collaboration related to nanoscale science and engineering and society, ultimately resulting in a 2004 solicitation for a Center for Nanotechnology in Society. This paper reviews one of two federally funded social science research centers established to address the need of responsible development– the Center for Nanotechnology and Society at Arizona State University (CNS-ASU) – and identifies impact and outcomes information from CNS-ASU participants through survey research. Systematically identifying impacts of the Center is critical to understanding whether or not a social science research center can respond effectively to complex public policy issues by conducting engaged social science. By measuring learning, use of concepts, skill-building, and perceived impacts, we assess CNS-ASU in terms of its mission to understand the merits of this form of engaged social science research where social science contributes not only to traditional knowledge production, but also to the capacity of individual researchers and research communities for greater reflexivity and responsiveness, ultimately for more socially robust research systems.

Tsjalling Swierstra and Merel Noorman

Tsjalling Swierstra (Maastricht University)
Merel Noorman (University of Tilburg)

Democracy by Design

Smart city digital technologies should be democratic, but how can policymakers and others align technological systems for public infrastructures with democratic decision-making processes in cities? How to avoid that the smart city develops as an essentially technocratic project? Starting from Mark Warren's 'problem-based approach to democratic theory', we present our 'Democracy by Design' diagnostic tool. The aim of this tool is to explore – possibly in advance - how digitalization affects – positively and/or negatively – core political practices that help democratic political systems to achieve their three main functions: empowered inclusion; collective will formation; and collective action. These core practices are 1) recognizing; 2) resisting; 3) representing; 4) deliberating; 5) voting; 6) joining; 7) exiting; and 8) doing. We will offer some brief examples of how the tool works in practice.

Michiel Van Oudheusden

KU Leuven

Ten years later: Flemish Technology Assessment is dead. Long live Responsible Research and Innovation

The Flemish tradition of Technology Assessment experimented with many methods of participatory engagement, including consensus conferences and participatory Technology Assessment (pTA), among others. This presentation traces some of the experiences of these changing processes over the past ten years, showing the trajectory of this tradition, and emphasizing the strengths and weaknesses, as well as the differing political models behind different technology assessment models. The outcomes, strategies for technology assessment, and lessons learned from the author's participation in *Nanotechnology for Tomorrow's Society (BE)* will be presented.

Harro van Lente

The NanoNextNL Programme - Lessons and Legacies

The NanoNextNL programme officially ended on 31 Dec 2016. Consisting of three clusters, the programme studied the dynamics of scientific and technological developments and their sectoral and institutional embedding and impacts (economic and otherwise) in society; society, including public perception and public engagement with nanotechnology developments; and governance questions for regulatory and ethical embedding of nanotechnologies. Recent evaluations of this program highlight the intellectual and institutional challenges of big nano ELSI. The author will provide reflection and analysis of what happened in the programme and how it changed the (flat) landscape in the Netherlands. The outcomes, strategies for technology assessment, and lessons learned will be presented.

Christopher Coenen

Parliamentary technology assessment facilitated by ITAS-KIT

Nanotechnology was considered a key technology for innovative developments in a wide variety of technological areas and fields of social application. Nanotechnology promised significant sales potential in many areas of the economy, potential environmental benefits and positive effects in the area of human health. On the other hand, critical voices were raising awareness of possible negative environmental and health consequences and ethical issues associated with the use of nanotechnology.

Given the tremendous opportunities that were attributed to this key technology for future economic and social development, and the uncertainties surrounding their use perspectives and the potential risks associated with their use, the Bundestag Committee on

Education, Research and Technology Assessment commissioned TAB in May 2001 to carry out a comprehensive study on Status and Perspectives of Nanotechnology. In this presentation the author assesses the outcomes, strategies for technology assessment, and lessons learned from this period of history in the German context.

Erik Fisher, Cyrus Mody, Harro van Lente, Michiel Van Oudheusden, Shannon Connely-Phillips, Christopher Coenen Session 5A

Arizona State University, KU Leuven, James Madison University, Maastricht University, Karlsruhe Institute of Technology

Collaborative Histories- an STS community considers the Nano social science of the past 10 years.

Abstract: Nanotechnology research investments at the turn of the millennium were often paired with novel societal research and sometimes policy or even legislative commitments to the responsible development of the new field of innovation. An STS community grew up around the Big Nano ELSI work and has influenced STS work and indeed innovation policy in many other fields. In conjunction with the 10 year anniversary of SNET, we propose a collective reflection on several of the "big social science" projects that were focused on nano approximately a decade ago, including the following: - Center for Nanotechnology in Society at ASU (USA) - Center for Nanotechnology in Society at UCSB (USA) - NanoNed / NanoNextNL (NL) - Nanotechnology for Tomorrow's Society (BE) - DEEPEN project (EU) - STIR project (USA) - Parliamentary technology assessment facilitated by ITAS-KIT (DE) With one individual from each group participating, we present a roundtable discussion: What happened within these projects? What were the major challenges and outcomes? How would we characterize our successes and failures? What have we learned? How has this influenced working with big science research today, and the many collaborations in which the SNET community participate?

Arie Rip Session 2B

University of Twente

Macro-anthropology of emerging technologies

In line with the importance of de facto governance, in general and definitely for newly emerging technologies, I want to claim that studying governance of newly emerging technologies like nanotechnology requires a macro-anthropological approach. In a collection of published articles of mine (with collaborators) which is coming out with Routledge later this year I have shown that by doing. (See appendix for an overview of the collection.) I can now draw out lessons and implications.

The book offers a sustained analysis of the life of nano, from scientific promises to societal governance and attempts to modulate developments. As such it is informative, but in its synthetic approach, also a challenge to the partial perspectives of the various actors involved and/or interested. Also, the "meso- and macro-anthropological" approach of the author exemplifies a novel approach to the study of emerging technologies, which will be interesting to scholars in different disciplines.

Franz Seifert Session 7C

University of Vienna

Do national anti-GM movements converge in the long term? The cases of Austria, Germany, France, Spain and the UK.

The notion of 'publics' with regards to NEST is a long-standing subject of debate. This contribution looks into a notion of the public which receives too little attention in NEST research given its key role in conditioning tangible decision making processes in democracy—protest movements operating in national mass publics in the context of globalization and supranational integration. Globalization and the emergence of the supranational EU polity has led to the expectation that national protest movements—historically firmly linked to the nation state—will converge in the long term. In the EU context, such a trend would give rise to some optimism as regards the chances for the emergence of a common European public sphere and civil society. The study therefore asks: are protest movements structured by the national context or does globalization and EU integration cause national movements to converge? Drawing on data from a protest event analysis over a period from 1995 to 2009, the study compares anti GM movements in Austria, France, Germany, Spain and the UK to shed light on this question. Focusing on the variables movement intensity, targets, action repertoires, dynamics and composition the comparison carves out both commonalities and national specificities and examines theoretical causal mechanisms. The study confirms that each national movement presents a specific picture while convergence remains comparatively insignificant and limited to few aspects. Movement convergence across national borders through globalization/Europeanization remains a remote perspective.

Danielle Shanley Session 1A

Maastricht University

Looking Forward, Looking Back: The Emerging History of Responsible Research and Innovation

'Responsible research and innovation' (RRI) is considered an emerging concept through which to think about the impacts and effects of science and technology. Since its emergence around 2010, RRI has seen unprecedented growth and is now pervasive across the European research landscape, with its own journal, its own professional organizations, several annual conferences, as well as government and intergovernmental funding and support. At the centre of the RRI discourse is its purported newness, as such little attention has been given to its history so far. Additionally, as RRI is oriented towards the future, to anticipating through scenario building and foresight exercises, its own past naturally seems to take a back seat. Yet, historical knowledge is a crucial part of any exercise in anticipation. In order to think about the future of RRI, we necessarily need to think about its past. RRI is often considered too new to have its own history, or else its history tends to be conflated with the history of technology assessment (TA). Based on qualitative interviews with individuals working in the field, I apply Rip's understanding of 'folk theory' to the history of RRI. I claim that a folk history of RRI is fast emerging which is being accepted through frequent use, quickly gaining enough authority to no longer be thought in need of questioning. I argue that despite TA's influence in shaping RRI, this folk history ignores other influences or alternative origins, alternatives which could provide vital lessons for thinking about the future of RRI.

Tamar Sharon Session 6C

Maastricht University

When digital health meets digital capitalism, how many common goods are at stake?

In recent years, all major consumer technology corporations have moved in to the domain of health research. This "Googlization of health research" (GHR), emerging at the intersection of digital health and digital capitalism, begs the question of how the common good will be served in this type of research. As many scholars in the field of critical data and science and technology studies contend, such phenomena must be situated within the political economy of surveillance capitalism in order to foreground the question of public interest and the common good. Here, trends like GHR are framed in terms of a double, incommensurable logic, where private gain and economic value are pitted against public good and societal value. While helpful for highlighting the exploitative potential inherent in digital capitalism, this framing is limiting, by failing to account for the presence of other evaluative regimes and conceptions of the common good that may be at work. In this paper I use the analytical framework of modes of justification developed by Boltanksi and Thévenot (2006) to identify a plurality of evaluative regimes and common goods in GHR. Not just the "civic" (doing good for society) and "market" (enhancing wealth creation) logics, but also an "industrial" logic (increasing efficiency), a "domestic" logic (taking care of one's own), and a "project" logic (innovation and experimentation). Drawing on research including promotional material of GHR initiatives and interviews with participants in GHR projects, I ask what moral orientations guide different actors. I contend that identifying this pluralism is necessary to avoid theory-practice discrepancies and to develop viable governance solutions.

Clare Shelley-Egan and Ellen-Marie Forsberg Session 7B

Oslo Metropolitan University

Consolidating RRI and Open Science: understanding the potential for transformative change

At European Commission level, RRI is being increasingly linked to new developments in research policy, such as the Open Science (OS) agenda. Recognition of the convergence of the two notions has resulted in the funding of European projects dedicated to integrating RRI and OS, as, for instance, the ORION project. RRI seeks to develop an open research and innovation system that can address the societal challenges of our time. In a similar vein, OS is viewed as having the capacity to transform science into 'better' science which means making science 'good', 'efficient' and 'open'. OS entails opening up the entire research process and necessitates novel - and systemic – approaches to undertaking and organising research. Indeed, both OS and RRI require transformative change in how research is practised. However, the specific features of the link between the two concepts have yet to be clarified, particularly with respect to how the two concepts might serve to reinforce each other. This paper will review the association between the concepts and will argue that, while OS is an important policy development, it lacks the resources to take the place of RRI in research policy and practice.

Gisle Solbu and Knut H. Sørensen Session 5C

Centre for Technology and Society, Norwegian University of Science and Technology

Auspicious, Anxious or Ambiguous Enactments? Studying the Socialisation of NET through News Media

How to cultivate the social benefits of new and emerging technologies (NET) while managing public issues and potential anxiety has been a long standing concern in science and innovation policy. Bijker and d'Andrea (2009) argue that this concern demands a special attentiveness to what they term the socialisation of technologies. This encompasses processes like sense-making, interpretation of future uses, communication of risks and social as well as ethical concerns. In this contribution, we draw attention to the news media as an arena for the socialisation of NETs through its capacity to serve as a site for public exchange on technoscientific issues. Using a comprehensive corpus of Norwegian news articles on bio- and nanotechnologies between 2010-2014, we explore in detail the mechanisms that contribute to the embedding of these technologies into society and the actors involved in these processes. We suggest the need to consider socialisation as a more ambivalent, comprehensive, and distributed activity than has been suggested in previous literature. Four modes of socialisation of NET are identified: (1) auspicious, (2) anxious, (3) ambiguous, and (4) trivialisation.

Bijker, Wiebe E., and Luciano d'Andrea, eds. 2009. *Handbook on the Socialisation of Scientific and Technological Research*. Rome: River Press Group.

Theodore Stone Session 1C

University of Maryland

'Google, Health, and Epistemic Injustice Within the Infosphere' - Politics and ethics of new and emerging sciences and technologies

In 2017, it was announced that Verily, a subsidiary of Alphabet (Google), would be conducting a 10,000-person-strong health study, albeit without revealing much about the prospective impact of the project. This emerged in the wake of the controversy, caused by another Alphabet subsidiary, DeepMind, who participated in a deal with the UK's Royal Free Hospital to use patients data without their explicit consent.

Being that Alphabet is a for-profit, commercial entity, with an agenda to obtain capital (financial and otherwise), we are left with a series of questions. In this new age, where privacy can be removed at the click of a button, is it feasible to claim that we have fundamentally private components of ourselves, or is everything up for grabs? By using Powles & Hodgson's (2017) study into this area, alongside Outomuro's (2015) examination of confidentiality in the field of medicine, I wish to raise the argument that, whilst improved healthcare is indeed vital for human flourishing (Rössler 2004), it is nonetheless essential to define where acts of Epistemic Injustice (Fricker, 2007) could be committed in order to ensure the release of biodata.

Using this, I will thereby argue that it is imperative that the construction of any successful form of macro-based Information Ethics must allow us to identity forms of Epistemic Injustice that could be committed by groups, such as Google, that possess a far larger array of epistemic tools than the individual.

Roger Strand Session 6C

Centre for Cancer Biomarkers & Centre for the Study of the Sciences and the Humanities, University of Bergen, Norway

Estimated Time of Departure

The imaginaries of technology-intensive, data-driven precision medicine are coproduced with the development of cancer research approaches that combine older traditions of molecular biology and epidemiology and big data collection and handling (-omics, bioinformatics, computational methods, novel imaging methods etc), as well as the politics and ethics of precision cancer medicine.

The promise of these imaginaries is often presented in terms of cure: That more cancers will be cured, perhaps even metastatic cancers as well; that more cancers will be prevented; and in the case of incurable disease, that the duration and quality of life will increase by tailored, effective and less harmful treatments. A central element in this vision is the integration of massive amounts of personal health information and biomarkers for better prevention, prediction and treatment of disease.

Still, a responsible examination of these imaginaries should take into account that cancer is likely to remain an important cause of death in societies with a highly developed healthcare system. This is not the least because other causes of death (notably infections and heart diseases) have become less prevalent. The imaginary of precision cancer medicine is therefore also one of science and technology for the anticipation of (inevitable) death. In this way, there are not only the questions about cognitive disorientation as the complexity of cancer research and cancer care rises but, importantly, questions about existential and ethical disorientation. How will the human condition change if the estimated time of departure from life becomes ever more precise? What is the relationship between a good life and the knowledge or ignorance about its end? Does it make sense to ask, as is done in some strands of medicine and health science, if there can be a good death? These questions are not new but they are acutely actualized by the development of precision medicine imaginaries and agendas, and above all so in the field of cancer. The author will present reflections based on his long-term ELSA/RRI-based collaboration (2013-2023) with cancer researchers in the Centre for Cancer Biomarkers, University of Bergen, Norway.

Nora S. Vaage Session 5C

Maastricht University

Gene Editing for Everyone? Discourses of DIY Biology's Involvement with an Emerging Technology

Do-it-yourself (DIY) biology practitioners have in the past decade become increasingly involved in the biotechnosciences. This involvement is seen both in public discussions, and through hands-on use of biotechnologies to modify living organisms, from bacteria in petri dishes to their own bodies. In the case of the new technology of CRISPR gene editing, DIY biology has been involved since the birth of the technology in 2012-13. The first DIY human gene editing experiment was performed in October 2017, when Josiah Zayner, CEO of a company distributing DIY gene editing kits, injected himself with a gene editing plasmid that could, if it worked, give him bigger muscles. In February 2018, following a stunt by the CEO of another biohacker-based company, Ascendance Bio, Zayner publicly regretted his actions and expressed his concern that somebody would get hurt, given the ways experiments were being undertaken. The proposed paper will examine and critically engage with the increasingly disjointed discourses of biohackers on the topic of gene editing and self-experimentation, especially focused on their treatment of various ethical issues of such experiments.

Ties van de Werff Session 6B

Maastricht University

Engaging with the Good: valuing popular neuroscience in society

In the past decade, knowledge and applications of the neurosciences have travelled from the lab to a variety of societal domains. Through popular-science books, self-help manuals, apps, and neurogadgets such as brain games, neuro-advocates offer all kinds of advice on how to best train our brains and improve our lives. Scholarly critiques on the impact of this neuro-turn in society either dismiss these popular applications as neurohype (Grubbs, 2016), or fear that they strengthen a "neoliberal ethic of personal self-care" (Pitts-Taylor, 2008). Both positions forego the question how such technical knowledge is made valuable in the first place. For what concerns and desirable ends is knowledge of the brain mobilized?

In my talk, I use neurohype as a rich resource for understanding public ethical deliberation. Building upon pragmatist ethics and the sociology of valuation, I empirically trace valuations of neuroscience knowledge in different societal practices of self-fashioning and flourishing. I show that it takes deliberate efforts to make brain claims valuable in these practices, efforts I call value work. It is through practical and contextual strategies of value work that the possible ethical implications and relevance of neuroscience are articulated: It allows advocates to mobilize and combine different concerns, action programmes, and ideals. The notion of value work thereby not only explicates the hidden moral labour that firmly stabilizes new and emerging science and technologies in society, but also demonstrates the reverse: the role science and technologies play in the (de)stabilization of our moral order.

Lucien von Schomberg & Vincent Blok Session 3C

Wageningen University

Innovation and the Character of our Age

Over the years the concept of Responsible Innovation (RI) has gained increasing importance at a global scale. In its implementation, both policy makers and researchers continuously discuss how to guide innovation processes in the 'right' direction. However, little thought goes to what concept of innovation is presupposed as self-evident today and what implications it has for the objectives of RI (Blok & Lemmens, 2015). From a philosophical perspective the following question arises: what is the character of our age and how does it determine the way we think of innovation today?

In a recent paper, Benoît Godin argues that a particular concept of innovation as technological and economically driven becomes dominant today (Godin, 2008); it is no longer understood as 'creation of change' or 'invention' in general, but in terms of new technologies and the economic benefit they bring. Even though the RI literature emphasizes the need for a political discourse of innovation, the technological and commercial nature of the way innovation is widely understood today is rarely brought into question. Can this common understanding of innovation ever lead to more responsible types of innovation? To what extent is it fundamentally at odds with a political discourse of innovation?

In light of Godin's observation, in this contribution we critically reflect on the ontological status of the presupposed concept of innovation in the RI literature. While innovation at the ontical level refers to particular technologies, and to how those technologies may mediate the human-world relation (cf. Idhe 1993, Verbeek 2005), innovation at the ontological level refers to the very mode in which these technologies currently reveal (cf. Zwier et al. 2016). Arguably, the latter is to be understood in relation to the very way we nowadays see, understand, and create those technologies; in relation, that is, to the character of our age.

Fern Wickson, Amaranta Herrero & Rosa Binimelis Session 7C

GenØk Centre for Biosafety

Seed-Links: Visualising diverse agri/cultures to help us teach and navigate contested food futures

The Agri/Cultures Project is working to develop novel concepts, methods and empirical knowledge for understanding the complex relational networks of different cultures of agriculture. One of the project's primary aims has been to explore new ways to capture and visualize these relational networks in engaging and accessible ways. The project has been motivated by the need to: a) see and assess genetically modified organisms not as isolated technological objects but as dynamic networks of social, ecological and technical relations entangled in integrated systems, and b) compare this model of agriculture with other approaches. Over the last four years, the project has been creating comparative cartographies of different agri/cultures (specifically, genetically modified, chemically intensive, certified organic and agro-ecological systems of production). It has been doing this through multi-sited ethnographic research in Spain and South Africa, inspired by the 'follow the thing' methodology. To visualize and compare the different agri/cultures, the project has now developed an interactive website (Seed-Links) as an innovative form of science communication. The aim of the website is to provide a pedagogical tool for exploring the differences that exist across different agri/cultures as a way to help people navigate the complexities of contested food futures. As such, it seeks to empower people to make more informed choices about the food they consume and the networks of relationships they invest in and build through their everyday choices. This presentation will showcase the seed-links website and seek feedback on the approach as a way of reconceptualising biotechnology and its analysis and as a method for performing transnational research on diverse agri-food systems.

Hub Zwart Session 5B

Radboud University Nijmegen

Synthetic biology, iconoclasm and imagination: The synthetic cell as a techno-scientific mandala

Although contemporary technoscience is iconoclastic (i.e. bent on replacing concrete, tangible entities by symbolic data: by biochemical and computerised symbols and codes), scientists are at the same time prolific producers of powerful images: images that allow audiences to come to terms with abstract and complex information, comparing it to something which is structured, familiar and concrete. In other words, images may guide us through massive and disorienting data streams. Synthetic biology is an outstanding example of a technoscientific discourse replete with guiding images (from the "barcode" of life up to "bio-bricks"). My paper focusses on a particular image, namely the mandala image as a symbol of restored unity and wholeness. Mandala images especially emerge in textual materials (papers, posters, PowerPoints, etc.) related to one of the new "frontiers" of contemporary technoscience, namely the building of a synthetic cell: a laboratory artefact that functions like a cell and is even able to replicate itself. The mandala symbol suggest that, after living systems have been successfully reduced to the elementary building blocks and barcodes of life, time has now come to put these fragments together again. This holistic turn towards the cell as a meaningful whole (a total work of technoscience) also requires convergence at the subject pole: a turn towards integration of multiple perspective and various forms of expertise.