



Schader Stiftung



TECHNISCHE
UNIVERSITÄT
DARMSTADT



Karlsruher Institut für Technologie

Public Panel – Schering Session “Science & Society”

Engineering Life? Responsible Research and the Limits of Design

Monday, June 23rd 2014, 6:30 pm at Schader-Forum, Darmstadt

Welcome Address

Alexander Gemeinhardt, M.A., Chairman of the Board,
Schader-Stiftung

Speakers

Dr. Dr. René von Schomberg, European Commission,
Directorate General for Research, Brussels
(in personal capacity)

Dr. James Philp, Organisation for Economic Co-operation
and Development (OECD), Directorate for Science,
Technology and Industry, Paris

Commentators

Dr. Stephen van Dien, Genomatica Inc., Director of
Technology Development, San Diego, CA, USA

Wolf-Michael Catenhusen, Deputy Chairman, German
Ethics Council, Berlin

Moderator

Prof. Dr. Alfred Nordmann, Technische Universität
Darmstadt, Institut für Philosophie

Open Discussion and Get Together

Both panel and discussion will be held in english,
but translation into german language will be available.

More Information: www.schader-stiftung.de/SYNBIO

The attendance to the panel is free. The number of participants is limited, so *please register until June 20th. To register, send your contact information to: kontakt@schader-stiftung.de*. Your registration will be confirmed via email.

Hotel

If you require accommodation, we will help to arrange reservations. Please contact us via email: kontakt@schader-stiftung.de or phone 06151/1759-0.

Arriving by public transport

To reach the Schader-Forum from the central station, please take tram 3 towards Lichtenbergschule to Goethestraße. The ride takes 15 minutes.

Arriving by car

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European science policy calls for “Responsible Research and Innovation”. This applies to Synthetic Biology even in its early stages of fundamental research. Regardless of whether it will “engineer life”, Synthetic Biology employs design principles where evolution used to reign. It builds up complexity to meet the demands of human practice rather than break down and simplify things to meet the demands of human understanding.

How does it select its research problems and what values guide its search for solutions? Where does it see the limits of design? Who are those student researchers that are the public face of Synthetic Biology? And which interests guide the development of its first commercial products?

What, then, is required for responsible research and innovation (RRI) in the field of Synthetic Biology? In order to answer this question, two perspectives must be brought together – that of governance, science policy, ethical deliberation, and that of research, its practice and economic prospects.

Realised with kind support from



In cooperation with SYNENERGENE, funded by the 7th Framework Programme of the European Union.



Place of conference

Schader-Forum
Goethestr. 2
64285 Darmstadt

Panel organizers

Dr. Harald König, Karlsruhe Institute of Technology, Institute for
Technology Assessment and Systems Analysis

Prof. Dr. Alfred Nordmann, Technische Universität Darmstadt,
Institut für Philosophie

Dr. Tobias Robischon, Schader-Stiftung

Schader-Stiftung

Goethestr. 2, 64285 Darmstadt
Phone: 06151/1759-0, Email: kontakt@schader-stiftung.de
www.schader-stiftung.de



Schader Stiftung



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KIT
Karlsruher Institut für Technologie

Öffentliches Forum – Schering Session „Science & Society“

Engineering Life? Responsible Research and the Limits of Design

Montag, 23. Juni 2014, 18:30 Uhr im Schader-Forum, Darmstadt

Begrüßung

Alexander Gemeinhardt, M.A., Vorstandsvorsitzender
der Schader-Stiftung

Vorträge

Dr. Dr. René von Schomberg, Europäische Kommission,
Generaldirektion für Forschung, Brüssel (in persön-
licher Eigenschaft)

Dr. James Philp, Organisation für wirtschaftliche
Zusammenarbeit und Entwicklung (OECD), Direktion
Wissenschaft, Technologie und Industrie, Paris

Kommentare

Dr. Stephen van Dien, Genomatica Inc., Forschungs-
direktor, San Diego, CA, USA

Wolf-Michael Catenhusen, Stv. Vorsitzender des
Deutschen Ethikrats, Berlin

Moderator

Prof. Dr. Alfred Nordmann, Technische Universität
Darmstadt, Institut für Philosophie

Offene Diskussion und Get Together

Die Veranstaltung findet in englischer Sprache statt.
Eine Übersetzung ins Deutsche ist verfügbar.

Weitere Informationen unter: www.schader-stiftung.de/SYNBIO

Die Teilnahme an der Veranstaltung ist kostenlos. Die Teilnehmendenzahl
ist begrenzt. **Anmeldungen bitte unter der Angabe Ihrer Anschrift bis 20.
Juni 2014** per E-Mail an: kontakt@schader-stiftung.de. Sie erhalten eine
Anmeldebestätigung per E-Mail.

Falls eine Übernachtung nötig ist, unterstützen wir Sie gerne bei der
Auswahl des Hotels. Bitte kontaktieren Sie uns über E-Mail: kontakt@schader-stiftung.de
oder telefonisch: 06151/1759-10.

Anreise mit dem ÖPNV

Mit der Straßenbahnlinie 3 vom Hauptbahnhof in Richtung Lichtenberg-
schule bis Haltestelle Goethestraße. Fahrtzeit 15 Minuten.

Anreise mit dem PKW

Bitte beachten Sie, dass das Schader-Forum über keinen eigenen Park-
platz verfügt. Im Straßenraum stehen nur begrenzt Parkplätze zur Verfü-
gung. Eine Wegbeschreibung mit Anfahrtsskizze finden Sie unter:
<http://www.schader-stiftung.de/service/anfahrt/>

Die europäische Forschungspolitik verlangt nach „verantwortbarer
Forschung und Innovation“ (Responsible Research and Innovation).
Für die Synthetische Biologie gilt dies bereits für die noch frühe
Phase ihrer Entwicklung. Unabhängig davon, ob sie nun künftig
„Leben konstruieren“ wird, wendet die Synthetische Biologie Kon-
struktionsprinzipien an, wo bisher die Evolution herrschte. Statt
die Dinge zu zerlegen und zu vereinfachen, um den Ansprüchen
menschlichen Verstehens besser gerecht zu werden, baut sie Kom-
plexität auf, um Ansprüche menschlicher Praxis zu decken.

Doch wie wählt sie ihre Forschungsfragen aus und welche Werte
leiten ihre Suche nach Lösungen? Wo sieht sie die Grenzen von
Design? Wer sind die studentischen Forscher, die der Synthetischen
Biologie in der Öffentlichkeit ein Gesicht geben? Und welche Inte-
ressen bestimmen die Entwicklung ihrer ersten kommerziellen
Produkte?

Was ist also erforderlich für verantwortbare Forschung und In-
novation im Bereich der Synthetischen Biologie? Um diese Frage
zu beantworten, müssen zwei Perspektiven zusammengebracht
werden – diejenige von Governance, Forschungspolitik und ethischen
Überlegungen, und diejenige der Forschung, ihrer Praxis und ihrer
wirtschaftlichen Perspektiven.

Ermöglicht durch die



In Zusammenarbeit mit SYNENERGENE, gefördert durch das
7. Forschungsrahmenprogramm der EU.



Veranstaltungsort

Schader-Forum
Goethestr. 2
64285 Darmstadt

Organisation des Forums

Dr. Harald König, Karlsruher Institut für Technologie, Institut für
Technikfolgenabschätzung und Systemanalyse
Prof. Dr. Alfred Nordmann, Technische Universität Darmstadt,
Institut für Philosophie
Dr. Tobias Robischon, Schader-Stiftung

Schader-Stiftung

Goethestr. 2, 64285 Darmstadt
Telefon: 06151/1759-10,
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www.schader-stiftung.de

Workshop

Responsible Research and Innovation in Synthetic Biology

23rd - 25th June 2014, Schader-Forum, Goethestr. 2, Darmstadt

Responsible research and innovation (RRI) has increasingly gained relevance in EU policy (such as in the European Commission's Science-in-Society programme and the Horizon 2020 strategy). The RRI concept aims to better align science and innovation to societal needs and ethical acceptability through an inclusive and deliberative process of stakeholder involvement and public engagement. Stakeholders should become co-responsible by constructive input to regulatory frameworks and innovation processes (e.g. defining societal desirable products).

In the workshop we aim to bring together various actors, including people from academic research, industry, civil society and politics to discuss in an experimental format questions concerning prerequisites for Responsible Research and Innovation (RRI). Four workshop sessions will highlight different issues or aspects linked to RRI and explore their relations and relevance for synthetic biology. The aim of this workshop is to contribute to developing critical questions or standards that should be considered in research and innovation processes in synthetic biology, or when discussing their results.

Monday, June 23rd, 2014, Schader-Forum

6.00 pm

Registration

Public Panel – Schering Session “Science & Society”

6.30 pm

Engineering Life? Responsible Research and the Limits of Design

Regardless of whether it will “engineer life”, Synthetic Biology applies design principles where evolution used to reign. What is required for responsible research and innovation in the field of Synthetic Biology? In order to answer this question, several perspectives must be brought together – those of governance, science policy, ethical deliberation, and those of research, its practice and economic prospects.

Welcome Address

Alexander Gemeinhardt, M.A., Chairman of the Board, Schader-Stiftung

Speakers

Dr. Dr. René von Schomberg, European Commission, Directorate General for Research, Brussels (in personal capacity)

Dr. James Philp, Organisation for Economic Co-operation and Development (OECD), Directorate for Science, Technology and Industry, Paris

Commentators

Dr. Stephen van Dien, Genomatica Inc., Director of Technology Development, San Diego, CA, USA

Wolf-Michael Catenhusen, Deputy Chairman, German Ethics Council, Berlin

8.30 pm

Get Together

Realised with kind support from



Tuesday, June 24th, 2014, Schader-Forum

1. Workshop Session

9.30 am

Value sensitive design

Implicit and explicit values, such as sustainability, or privacy and safety (by design), have increasingly gained relevance in both research policies (e.g. related to nanotechnology) and in certain technology sectors (e.g. chemicals; energy; information and communications technology). Key questions in this session will address how and at which stage approaches for value-sensitive design could play a role in synthetic biology developments.

12.00 am

Lunch

Workshop - Responsible Research and Innovation in Synthetic Biology

<u>1.30 pm</u>	2. Workshop Session Conditions for Co-Responsibility – Rights and Privileges, Commitments and Obligations Research and development in (potential) key technologies can be shaped by various societal actors. These range from investors, public or private research, the legislature, to certification bodies for sustainable production of goods. Major questions to be discussed here will be related to appropriate institutional models for constructive stakeholder participation and input in the innovation process in synthetic biology.
<u>3.30 pm</u>	Coffee
<u>4.00 pm</u>	3. Workshop Session Responsible Representation – Knowledge and Ignorance, Limits of Control This session should shed light on potential issues for RRI derived from self-portrayal of the synthetic biology field or its portrayal from the outside. Such issues may arise from under- or overstating tensions between notions of construction and design on the one hand, and limits of knowledge and control, emergent properties and evolutionary change of living systems, on the other hand. Questions will address how and by whom synthetic biology is represented and presented. And how this determines what we learn about the field; the mindsets, notions and research ascribed to it (or its actors); or what researchers in the field do actually know – and what achievements they may, or may not, provide in the future.
<u>6.00 pm</u>	End of first day
<u>Evening</u>	Joint Dinner

Wednesday, June 25th, 2014, Schader-Forum

<u>09.30 pm</u>	4. Workshop Session Monitoring, Observation and Regulation – Collective Experimentation and Social Learning This session aims to discuss and explore possibilities for translating knowledge and uncertainty into responsible decision making and governance processes. Points of departure will be existing governance structures and societal analysis by the social sciences that may represent collective or 'real' experimentation on emerging technologies. Questions here will relate to strategies for dealing with unknown and unpredictable technological developments, benefits and risks. A further focus will be on political conditions that may encourage experimental playing fields on which new governance schemes can develop. Ideally, these should be able to foster new opportunities and responsibly govern potential transformations linked to synthetic biology and possibly other emerging technologies.
<u>12.00 am</u>	Resumee – Conclusion and discussion of follow-up activities
<u>1.00 pm</u>	Lunch
<u>1.30 pm</u>	End of workshop

Rather than featuring a sequence of talks or presentations, the workshop will stage roundtable discussions on four topics. Each of the four topics will start with a brief presentation of an example or potential 'prototypic' model case related to RRI (by workshop participants or the organizers) as well as a set of questions and theses.

In cooperation with SYNENERGENE, funded by the 7th Framework Programme of the European Union.



Arriving by public transport

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Place of conference

Schader-Forum
Goethestr. 2
64285 Darmstadt

Workshop organizers

Dr. Harald König, Karlsruhe Institute of Technology, Institute for Technology Assessment and Systems Analysis
h.koenig@kit.edu

Dr. Sabine Ammon and Prof. Dr. Alfred Nordmann, Technische Universität Darmstadt, Institut für Philosophie
ammon@phil.tu-darmstadt.de, nordmann@phil.tu-darmstadt.de

Dr. Tobias Robischon, Schader-Stiftung, robischon@schader-stiftung.de

Schader-Stiftung

Goethestr. 2, 64285 Darmstadt
Phone: 06151/1759-0, Email: kontakt@schader-stiftung.de
www.schader-stiftung.de/Synbio

Engineering Life? Responsible Research and the Limits of Design

„Responsible Research and Innovation“ (RRI) has increasingly gained relevance in EU policy. There are numerous expert-group reports, funded research projects, books, and an international Journal of Responsible Innovation. The concept plays a major role in the European Commission’s Science-in-Society programme, the Horizon 2020 strategy, in the funding process of national research councils. The RRI concept aims to better align science and innovation to societal needs and ethical acceptability through an inclusive and deliberative process of stakeholder involvement and public engagement. Stakeholders should become co-responsible by constructive input to regulatory frameworks and innovation processes, e.g., by defining societally desirable products.

The EC-funded SYNENERGENE project (www.synenergene.eu) is dedicated to “Responsible Research and Innovation in Synthetic Biology,” that is, even in the early stages of the research process. Regardless of whether it will “engineer life”, Synthetic Biology (SynBio) applies design principles where evolution used to reign. By building up biological complexity it seeks novel ways of meeting demands of human practice. How does it select its research problems, what values guide its search for solutions, where does it see the limits of design, who are those student researchers that are the public face of SynBio, which interests guide the development of its first commercial products? – In short, what is required for responsible research and innovation (RRI) in the field of Synthetic Biology?

In order to answer the question of this workshop, the opening session brings together two perspectives – that of governance, science policy, ethical deliberation, and that of research, its practice and prospects. But as these concepts are related to one another, what is SynBio, what makes it special, and what is RRI, what does it require?

- SynBio, is it a new field of research as opposed to molecular biology or genetic engineering – or is it a new way of doing research, a different mind-set or engineering approach in biology?
- RRI, is it an umbrella term that collects together many ideas about science and society, about stakeholder participation, matters of ethical concern – or does it aim for a new form of governance, for novel ways of ensuring the mutual responsiveness of researchers and societal actors?

It depends on the answer to these questions (see the back of this page), how we might conceive of „Responsible Research and Innovation in Synthetic Biology.“

Speakers: Dr. Dr. René von Schomberg, European Commission, Directorate General for Research, Brussels (in personal capacity) - Dr. James Philp, Organisation for Economic Co-operation and Development (OECD), Directorate for Science, Technology and Industry, Paris

Commentators: Dr. Stephen van Dien, Genomatica Inc., Director of Technology Development, San Diego, CA, USA - Wolf-Michael Catenhusen, Deputy Chairman, German Ethics Council, Berlin

4 dimensions of Responsible Research and Innovation

- Value-sensitive design
- Conditions for co-responsibility: rights and privileges, commitments and obligations
- Responsible Representation : Knowledge and Ignorance, Limits of Control
- Monitoring, Observation and Regulation – Collective Experimentation and Social Learning

Synthetic biology builds, for constructive purposes, on achievements of technical control of biological complexity. Indeed, on some accounts of what synthetic biology is and how it works, it does not even appear to be interested in traditional scientific methods of reducing complexity by intellectual means. Instead, it promotes the controlled generation of complexity by technical means, that is, by drawing available theories and tools into a technoscientific design process.

Alfred Nordmann

Synthetic Biology is the engineering of biology: the synthesis of complex, biologically based (or inspired) systems which display functions that do not exist in nature.

EC High-level expert group

Five keys to Responsible Research and Innovation:

- open access
- ethics approval
- science education
- gender equality
- public engagement

European Commission (2012)

Synthetic biology is the design and construction of biological devices and systems for useful purposes.

Wikipedia

Responsible innovation means taking care of the future through collective stewardship of science and innovation in the present. [...]

The four dimensions of responsible innovation

- anticipation
- reflexivity
- inclusion
- responsiveness

Owen, Stielgoe, Macnaghten

If you ask five people to define synthetic biology, you will get six answers. I'd say it is the (re-)design, construction and analysis of biological systems or sub-systems.

L. J. Prather

[Synthetic biology] is turning us into creators of the most basic parts of living nature. It opens up the possibility to augment nature with neo-microbes by an effort of engineering.

Joachim Boldt / Oliver Müller

Responsible Research and Innovation is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society).

René von Schomberg

Workshop-session 1:

Value-sensitive design

Implicit and explicit values and “societal needs”, such as sustainability, or privacy and safety by design, have increasingly gained relevance in research policies (e.g. related to nanotechnology) and in certain technology sectors (e.g. in communications technology). A key concept of synthetic biology (SynBio) - put forward by most actors both from within and outside the field - is the generation of biological parts, functions and organisms. Questions in this session will address the possibilities and potential limits for value-sensitive design in synthetic biology, research and development (R&D) processes,

Relation to later sessions: The search for good ways of incorporating societal interests and values into the research process may well (but need not) include questions of stakeholder involvement. Only in the next session will we be looking at the rights and privileges, commitments and obligations that come with the participation of researchers, stakeholders, publics.

Guarantors of social-orientation

- Public academic science
- Do-it-yourself biology
- Open-source approach
- Consumer choices

The Prototype

An example of good practice.

- good enough?
- how generalizable?
- other examples?

The value of value-free science?

- Unorthodox, unpopular ideas
- Freedom of research
- Who speaks for future generations, marginalized social groups, developing countries

- Software engineering: Privacy by design
- Nanoparticle toxicology: Safety by design
- SynBio: by design?

How to arrive and operationalize definitions?

biosafety – biosecurity – sustainability –
economic growth – biodiversity – de-skilling –
creativity – risk-and-benefit-sharing

- Whose values?
- What values?
- Competing values?

New / unique / “game-changing”
methodological or technical
possibilities in SynBio that could
facilitate value-sensitive design
approaches?

Research problems – how are they
formulated in SynBio?

Research methods – where do they
open up to considerations of values?

The promise of rational design – a
problem also of value-sensitive
design?

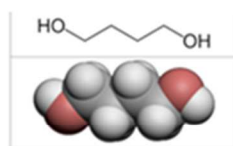
A possible 'prototypic' model: Production of 1,4-butanediol from renewable materials by a synthetic pathway in bacteria (Stephen van Dien, Genomatica)

1,4-butanediol (BDO) is an important commodity chemical produced from oil and natural gas, and not synthesized by any known organism. Industrial-scale production of BDO from renewable sources was achieved by designing a 'synthetic' pathway in the bacterium *E. coli* that had no "blueprint" in nature. It was constructed involving a high degree of rational design based on *in silico* algorithms.

Metabolic engineering of *Escherichia coli* for direct production of 1,4-butanediol



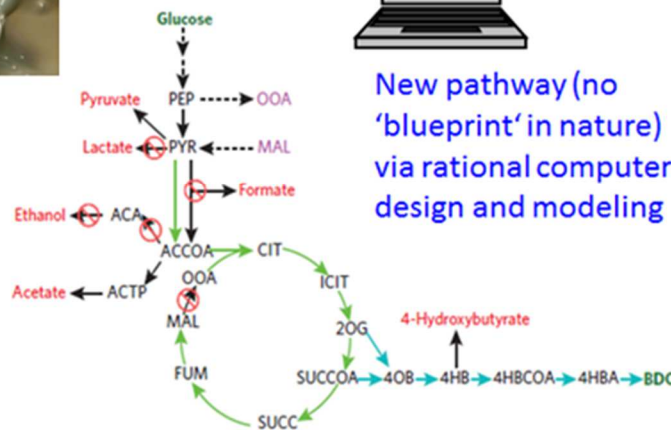
1,4-butanediol (BDO)



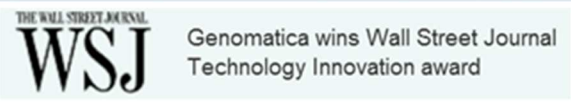
e.g. plastics, rubber, solvents
 (2.5 Mio t/ year;
 market value ~ \$ 4 Mrd)



New pathway (no 'blueprint' in nature) via rational computer-based design and modeling



Genomatica wins EPA Presidential Green Chemistry Challenge Award



BASF The Chemical Company
 BASF produces commercial volumes of BDO using our process; offering to customers

From: <http://www.genomatica.com/>

Workshop-session 2:

Conditions for co-responsibility – Rights and privileges, commitments and obligations

Research and development in (potential) key technologies can be shaped by various societal actors. These range from investors, public or private research, the legislature, to certification bodies for sustainable production of goods – not to neglect the roles of NGOs, consumers, or journalism. However, consequences of technological innovation are often the effects of collective action or societal effects which cannot be linked to intentional individual actions: How can individuals be embedded in a process of co-responsibility? – What are appropriate institutional models for constructive stakeholder participation and input in the innovation process in synthetic biology.

Relation to later sessions: This session focuses on agenda-setting and the ways of matching scientific and technological capabilities to societal needs – what expectations become associated with SynBio and what are people willing to do in order to make them come true? For the most part, this involves different governance processes than those that are associated with the regulation, dissemination, and appropriation of novel technologies. Also, we need not discuss here how to make sure that the expectations or motivations are realistic and not just heuristic.

The Prototype

A good example of effective governance beyond the state.

- good enough?
- how applicable?
- other examples?

Stakeholder participation – What is the price of admission?

- monetary: businesses pay a fee that allows civic actors to join in?
- commitments to transparency: no data no say?
- room for dissent: minority views get special representation?
- right to pose questions, obligation to provide answers?

Responsiveness

- voluntary codes of conduct with public accountability?
- certifying the pedigree of SynBio innovations (inclusiveness and comprehensiveness of attendant deliberations)
- public disclosure of best laboratory practices (in scientific publications: along with methods section a section on precautions take, IRB process)

Constitutionality

- a framework of principles (precaution, sustainability, biodiversity, fair distribution of benefits and risks)
- definitions of advisory roles and uptake
- relations to decision-making bodies, parliamentary and public debate

„design“

- a platform for all actors: policy makers, researchers, consumers – working together in the design of novel solutions?
- do-it-yourself biology, iGEM, citizen science, the promise of de-skilling biology – opening a two-way street between science and society?
- proto-typing – collective expertise for vetting proofs of concept

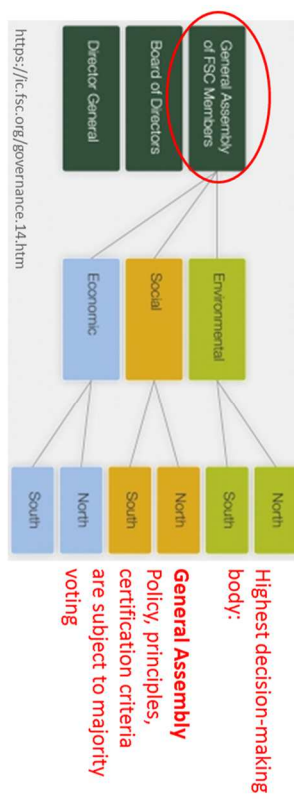
Forest Stewardship Council (FSC)



- Not-for-profit international organization
- Established in the early 1990s to promote the responsible management of the world's forests
- Various societal actors, incl. NGOs and profit-making firms
- Forest owners can apply to have their forests certified by independent certification bodies accredited and monitored by the FSC
- FSC also provides certificates allowing retailers to label wood-products as having been produced to FSC standards → FSC logo for marketing
- System is entirely voluntary
- Expectation: enough environmentally conscious consumers give retailers and forest owners a commercial incentive to work with the FSC

20/06/2014 Harald König 

“Society-centered, non-state governance”



20/06/2014 Harald König 

Roundtable on Sustainable Biomaterials (RSB)



- Not-for-profit international initiative
- Set up in 2007 to ensure sustainability of biofuels; expanded in scope in 2013 to cover biomaterials (“products derived from biomass”)
- Various societal actors, incl. NGOs and profit-making firms
- Promote / provide global standard for socially, environmentally and economically sustainable production and conversion of biomass
- certification system involving independent third party certification bodies (overseen by an independent accreditation body; Accreditation Services International)
- Provide a global platform for multi-stakeholder dialogue and consensus building
- Participation is open to any organization working in a field relevant to biomaterials sustainability

20/06/2014 Harald König 

RSB and Synthetic Biology

- May 2014: Amyris, Inc. received RSB certification
- Farnesene (“Biofene”), produced from Brazilian sugarcane by “SynBio-derived” yeast (at the Amyris biorefinery in Brotas, São Paulo state)
- Farnesene → specialty products such as cosmetics and perfumes (emollient squalane and fragrance oils); detergents; industrial lubricants; transportation fuels (e.g., diesel; jet fuel)
- Members in RSB chambers for Industrial biofuel / biomaterial producers
- e.g., Solazyme (USA); Genencor/Danisco (Belgium); Gevo (USA)

20/06/2014 Harald König 

Workshop-session 3:

Responsible representation – Knowledge and Ignorance, Limits of Control

Synthetic Biology's primary focus appears to be not on the discovery and testing of grand explanatory theories, but on problems that need to be solved to enable next steps within a larger research project, emphasizing the need for innovation and economic growth. It thus contributes to a design process, broadly conceived, e.g., to develop cures for disease, to improve the collection and storage of energy. Synthetic Biology does not speak from a place of intellectual privilege but must earn its trust by proving good citizenship on the testing-ground of collective design processes.

Responsible Research and Innovation begins with an adequate self-understanding of practitioners in the field of synthetic biology but also needs to be seen for what it is by outsiders (and not just: for what it might come up with in the future). How to resolve the tension between ambitions for construction and design on the one hand, and on the other hand the appreciation of limits of knowledge and control, emergent properties and evolutionary change of living systems. How is synthetic biology presented and represented?

Relation to other sessions: „Responsible representation“ is not normally discussed. It is akin to the demand for reflexivity but is more general, more pertinent, more public: How do practitioner reflect their own work as they present it in public, and what claims about the future of synthetic biology are taken for granted to

The Prototype

A model for a new generation of citizen scientists – the public face of Synthetic Biology?

- good enough?
- does academia accommodate it?
- relation to DIY and „garage“ biology
- other examples?

Watch your words?

- mechanisms
- design (vs. evolution), evolutionary design (vs. breeding)
- improving upon nature
- a new industrial revolution

Vested interests

- who pays - now and later
- who profits – now and later
- public interests in publically funded research
- dual use perspectives
- public disclosure for pedigree-assessment: what is the story behind this research (why/how did it get started, who participated in it, provided feedback, funded it with what expectations?)

Hubris and humility

- limits of complexity, limits of knowledge and control
- what are „proofs of concept“
- the problem of evolution
- comparative perspective (SynBios technical solutions vs. ??)

Public Debates

- watchdog group for exaggerated claims
- journalists, TA and ELSA researchers, civil society organizations – what are they talking about?

What is iGEM?

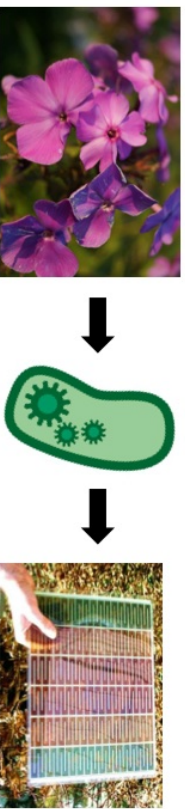


- Worldwide **SynBio** competition
- Construction of **biological machines**
- Development and characterization of genetic parts (**BioBricks**)
- Risk analysis**
- Political, social, economic, legal, ethical and philosophical impacts (**Policy & Practices**)



17.06.2014 | iGEM TU Darmstadt 2014 | Daniel Sachs & Sven Jäger | RRI in SynBio | 2

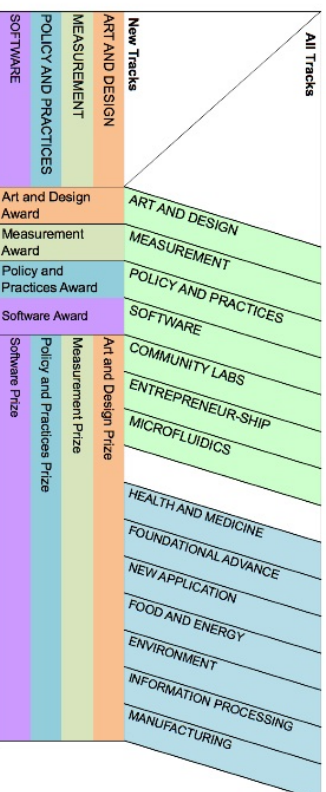
TU Darmstadt 2014



- Anthocyanin** production in *E. coli*
- Use in environment-friendly solar cells (**Grätzel cells**)

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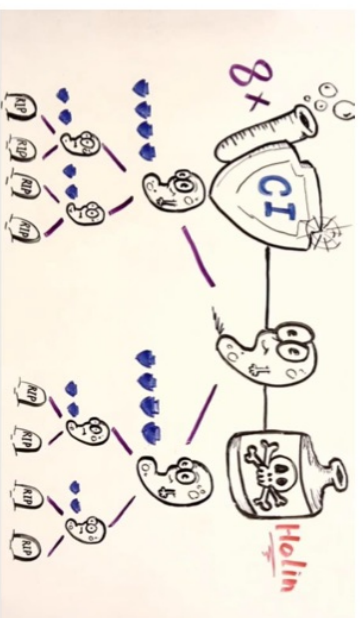
iGEM Tracks



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Self-induced kill-switch for biosafety by design

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its benefit and detriment?

Workshop-session 4:

MONITORING, OBSERVATION, AND REGULATION – COLLECTIVE EXPERIMENTATION AND SOCIAL LEARNING

This session aims to discuss and explore possibilities for translating knowledge and uncertainty into responsible decision making and governance processes. Points of departure will be existing governance structures and societal analysis by the social sciences that may represent collective or 'real-world' experimentation on emerging technologies. Questions here will relate to strategies for dealing with unknown and unpredictable technological developments, benefits and risks. A further focus will be on political conditions that may encourage experimental playing fields on which new governance schemes can develop. Ideally, these should be able to foster new opportunities to responsibly govern potential transformations linked to synthetic biology and possibly other emerging technologies.

Relation to other sessions: If workshop session 2 dealt with questions of governance regarding agenda-setting and the organization of research, this session concerns the adoption, diffusion, and appropriation of new products and processes.

Assumptions

Synthetic biology operates at the limits of knowledge and control of complex systems.

Even where technical robustness is achieved, knowledge of potential impacts on human, societal, and environmental health will be incomplete – systematically incomplete if long-term evolutionary effects need to be taken into account.

Thus, the standard model of pre-market regulation by safety and threshold determinations will be insufficient.

Institutions for permanent real-time vigilance

- ethically trained lab-scientists
- TA and ELSA-researchers
- PREEM (Public Response to Emerging Entities Monitoring Group)
- regulatory agencies
- SynBio commissions

Powerful concepts

- exchanging goods across trading zones
- co-design as experimental ethics
- social learning from collective experiments with emerging technologies in society as a laboratory
- anticipatory governance
- certification (e.g. of the social quality of research)
- hermeneutics of envisioned futures – vision/eering assessment
- the art vs. (management) science of governance

The Prototype

A model for governance in real-time

- good enough?
- the role of government (accreditation of biotech labs, tracking material flows)
- other examples?

Anything new?

- strengths and weaknesses of existing biotechnology governance
- criteria for ascertaining novelty
- sectoral differences: biofuels, pharmaceuticals, agrifood

Obstacles

- intellectual property rights
- national and corporate competition
- technoscientific hubris: designing biological processes or entities, designing their sociotechnical impacts, designing the people who can manage unknown unknowns

“Trading zones” as a set of methods for collaborations between different “epistemic cultures,” meaning collaborations across disciplines and sectors, with the goal to address the uncertain and complex challenges posed by synthetic biology.

Across Fields. The metaphor of “trading zones” was coined and developed by Peter Galison in 1997 “to explain how scientists and engineers from different disciplinary cultures manage to collaborate across apparently incommensurable paradigms.” Galison used the “trading zone” metaphor to explain how different epistemic communities, despite coming from contrasting scientific paradigms, are able to develop a communication process. As elaborated by Pauwels (2013), the “trade” metaphor adequately captures the way academic experts meet, exchange ideas, mutually learn and return to their respective epistemic communities with concrete “goods” in the form of improved research practices. And even though Galison (1995) used this metaphor in very specific case studies in physics, the concept can be used to better understand interdisciplinary collaborations among academics, scientists, social scientists, engineers and ethicists across all fields.

Across sectors. The Environmental Defense Fund (EDF) and DuPont partnership is a broad collaboration of interested stakeholders to minimize, identify and address the potential environment, health or safety risks of nanotechnology, so that the society can embrace and reap the benefits of nanotechnology’s promise. In 2007, EDF and DuPont launched *The Nano Risk Framework* with the purpose of proactively developing responsible nanotechnology standards in advance of government regulation. The framework was created by a multidisciplinary team from EDF and DuPont, (including experts in biochemistry, toxicology, environmental sciences and engineering, medicine, occupational safety and health, environmental law and regulations, product development and business development) to establish a process for ensuring the responsible development of nanoscale materials, which can then be widely used by companies and other organizations. In order to ensure responsible development of nanoscale materials, the framework provides guidelines for the responsible development, production, use, and end-of-life disposal or recycling of engineered nanoscale materials across a product’s lifecycle.

Both the concepts of interdisciplinarity and cross-sector collaboration indicate that technology exists in an ecosystem, rather than in a linear pathway. The assessment process should not just be upstream but also anticipatory, iterative and flexible where knowledge is gathered from different end points. These two approaches also echo Jasanoff’s concept of “technology of humility.” Jasanoff explains this as “a need [for technology of humility] to complement the predictive approaches: to make apparent the possibility of unforeseen consequences; to make explicit the normative that lurks within the technical; and to acknowledge from the start the need for plural viewpoints and collective learning.”

For Further Reading and References:

The above proposal is mainly extracted from the SYNENERGENE Report produced by Eleonore Pauwels and Manjyot Bhan, coming spring 2014.

Pauwels, E. (2013). Metaphors and Cohabitation Within and Beyond the Walls of Life Sciences. In *Early engagement and new technologies: Opening up the laboratory* (pp. 207-230), N Doorn, D. Schuurbijs, I. van de Poel and M. Gorman (eds). Springer Netherlands.