

A catalogue on Social Science Research topics in Synthetic Biology.

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SUMMARY

This deliverable aims to compile a catalogue on Social Sciences (SS) Research topics in Synthetic Biology (SB). This exercise will be based on information already collected within ERASynBio strategic conferences, and also on information collected through a desk based exercise.

This analysis will be made under the H2020 framework “Science with and for Society” in the following terms;

1. What’s the meaning of Science with and for Society, today? General overview about the concept and its evolution
2. What is synthetic biology (SB) and what is special about it? Is there a justification for the emergence of new SS research topics?
3. By listing the special characteristics of SB and its actual and potential impacts on society, identify where do we need to call for social sciences expertise, that will ensure a rightly progress of SB research?
4. And finally a summary on the main areas that will encompass the SS research topics, with a list of suggested actions – Catalogue. This list does not intend to be exhaustive, or detailed, but identify the main topics that need Social Science research.



1. INTRODUCTION

Science and Society - Science in Society – Science with and for Society

Today, we all recognise that science is no longer an isolated activity, but is embedded in many aspects of our lives. Science brings immense impacts to society, both beneficial and/or detrimental and therefore it is essential that the public is called upon to form an opinion and be part of the decision-making. It is therefore a priority to bring these two works together, and despite science's rapid progress, struggle to find a common language and communicate.

The European Commission has recognized long ago, that science needs to be integrated in the whole society, as shown by the evolution of the EU strategies and research programmes that have increasingly committed efforts and resources to support activities related to the integration of Science in Society.

In November, 2000 the document “Science, Society and the Citizen in Europe”,¹ set out the basis for the beginning of a debate, that resulted in the “Science and Society action plan”.²

In 2005, the Science and Society forum³ recognized that “communication is not only about informing the public but there should be a real engagement of the civil society and the public”.

In FP7 the term Science and Society was changed to “Science in Society”, to emphasize the idea that the two are merged in each other, and **science should be considered a social activity integrated in the remaining of the society**. The Science in Society (SIS) FP7 Programme⁴ represented a step forward on the previous FP6 activities, with the allocation of larger budget for new and better coordinated activities, involving different actors and emerging themes and this trend continues into the H2020 strategy.

Under H2020, the “Science with and for Society” Programme⁵ aims to “build an effective cooperation between science and society, to recruit new talent for science and to pair scientific excellence with social awareness and responsibility” introducing the Responsible Research and Innovation (RRI) concept that aims to ensure that societal actors work together during the whole research and innovation process.

Currently an open public consultation on “Science with and for Society”⁶ is opened until October 12th, 2014, to collect potential priorities and concrete suggestions for EU Research and innovation funding in the work programme 2016-2017, with the objective to “build effective cooperation between science and society, and to pair scientific excellence with social awareness and responsibility.”

And in practical terms what are the activities that should support this integration?

There have been several orientations, evolving along a growing awareness on this subject, which include activities that will support social engagement from many perspectives such as encouraging dialogue, adherence to ethical standards, a better divulgation of research results, attracting young people to science and research careers and implementing measures to balance gender equality in science, but also many others activities that will relate science to economics, politics, law, environment, democracy, culture and education.

2. SYNTHETIC BIOLOGY IN THE CONTEXT OF SOCIAL SCIENCES

Having described the EU guidelines for societal integration within the whole research and innovation process, let us look at synthetic biology. How does it fit? Does it bring any novelty, beyond other scientific research disciplines? Will it justify the emergence of any specific social science research topics?

2.1. Definition, scope and applications of synthetic biology

Synthetic biology is a converging technology, that uses tools and concepts from different disciplines such as biology, chemistry, physics, computer science and engineering, and brings unprecedented progress in creating the next wave of key technologies with promises to have great impacts on medicine, industry and environment, but also, brings risks for potential health and environment

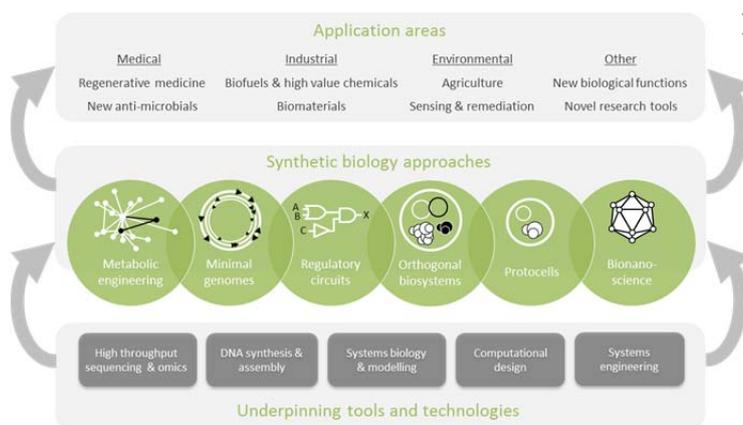


Figure 1: Disciplines employing the synthetic biology approach, synthetic biology application areas and underpinning tools and technologies

hazards. SB will create economic value, but, if not carefully managed, can lead to monopoly exploitations. At the limit, it has the potential to create life, with all its philosophical and ethical implications, and can easily unleash unrealistic, fantastic and scary wanders.

As with any rapidly evolving field, many different definitions of synthetic biology have been proposed and are in common use. The ERASynBio definition is the following:⁷

“Synthetic biology is the engineering of biology: the deliberate (re)design and construction of novel biological and biologically based parts, devices and systems to perform new functions for useful purposes, that draws on principles elucidated from biology and engineering”

3. SOCIAL SCIENCES integration in SYNTHETIC BIOLOGY research

From what was said, it seems that Synthetic biology has some particularities, some of them not apart from other emergent new technologies such as the nanotechnology or genetic modification, but in some aspects, taking steps forward.

Where can the social science research integrate with the synthetic biology scientific activity? Where can we establish useful connections between the Social Science expertise and Synthetic Biology particularities?⁸ In this section some fundamental synthetic biology aspects will be highlighted followed by suggestions of potential SS interventions that could facilitate SB growing potential.

3.1.Synthetic Biology is an emerging, new discipline and as such, it will to some extent, deal with the unknown. This implies a good measure of expectations, ambivalences and also misunderstandings, mostly related to risks and safety issues, but also to other potential impacts on legal frameworks, justice and economics. All these concerns can easily lead to a great deal of hypes or bluffs that at the end will hamper its progress, right from its beginning. In this context, SS by using scientific methods and systematics approaches towards understanding phenomena affecting society, can help to provide **assessment, understanding, monitoring and management of scientific development** and elucidate about what is really happening, where are the problems and what needs to be done, at the different levels and areas, such as safety, security, legal framework, information sharing, or even sociological and psychological aspects, taking into account the role played by languages, history and different cultural realities within Europe. These studies should be implemented when required, at both national and European levels, trying to integrate these results into decision-making process.

3.2 Along with synthetic biology's promises of great impacts on society whether beneficial, spectacular or disturbing, comes the need of a rightly communication of synthetic biology. Communication, through its several channels, contents and interlocutors, is an overarching concept that will require the **collaboration** of a wide range of social science expertise that will be able to act upon **public awareness, public dialogue** and **stakeholder involvement**, that will lead to RRI, as defined by EU.

Public awareness - In order to bring science policies closer to citizens there is a need to educate and improve public knowledge of science - the information needs to be understandable, of high quality and have a direct access through a specific cultural population.

The information should be conveyed in a creative way capturing public attention, by challenging and promoting citizens' thinking. There are already practical examples of SB public communication strategies taking advantage of artistic and cultural approaches, such as *Synthetic Aesthetics*⁹, or

*Biofiction*¹⁰ among others,¹¹ but there is room and need for much more, in terms of science communication, innovation and reach of a wider audience.

Public dialogue - going beyond the above mentioned actions that actively inform and educate the public, a true dialogue must be instituted between science and society, enabling the public to form an opinion. The combination of expert's advice with public dialogue has led to the ELSA concept developed under FP7 which has evolved further into the concept of Responsible Research and Innovation (RRI) developed under H2020, meaning that we want an increased contribution from the public. Today a fully integrated citizen perspective is expected, right from the beginning of a research proposal. **More than just contributing to a dialogue**, the EU wishes that the **public will be able to effectively contribute to public policy**, and thereby promote a better alignment of science and innovation with societal needs and ethical acceptability.¹² There has been a great number of initiatives to operationalize these intentions, such as on-line forums, consensus conferences, national and regional consultations, participative foresight programmes, debates, interactions with iGem, citizens' jury etc.. Again that is room and requirement for much more, in quantity, quality and reach of a wider and diversified public.

This dialogue involves a **close cooperation between a wide range of stakeholders** from research organisations, public authorities, media, citizen's civil society, enterprises, etc. **with the scientific and technological community** that will play an essential role by presenting issues of interest to the public at large, and by contributing to the debate.

However these interactions are not straightforward and need support for improvement. There is a lot of misunderstanding in these relationships that are imbued with prejudices. The image and role of scientists need to be adjusted to reality, the scientist's awareness of their responsibilities before the public need to be enhanced¹³, and also the acceptance of the important role of social scientists as mediators in these dialogue needs to be supported.^{13,14}

In this context, SYNENERGENE¹⁵ is an FP7 four-year mobilization and mutual learning action plan (MMLAP), that aims to initiate and foster public dialogue on synthetic biology and mutual learning processes, among a wide variety of stakeholders from science, industry, civil society, education, art and other fields.

3.3. Philosophical, Ethical, global justice, freedom of research

SB aims to engineer biological components and systems that do not exist in nature and re-engineer existing biological components. Synthetic biology is capable of creating new genetic material, new building blocks, new organisms and, at the limit enhanced or super human beings. These endless possibilities raise many issues related to ethical and social benefits considerations¹⁶, and also philosophical reflections on the status, dignity and conceptions of life.

A number of reports¹⁷ have been dedicated to analyse the ethical dimension of SB, and have recognized the relevance of the safety and security issues, as well as the implications for social justice and biodiversity. These reports have compiled a number of recommendations on governance and specifically on how research should be conducted in a socially and ethical responsible manner. However so far, there has been no restriction in terms of setting boundaries or limits to the research. This freedom of research and good will to comply with the actual regulations does not exonerate the obligation to be attentive, as there are many critical questions whose answers need to be monitored:

- How far should we go, in the name of a specific application to justify the risks and implications for the future people?
- Who will benefit from the distribution of products and knowledge arising from synthetic biology research?
- How far should be invested in a certain application that will benefit only a minority of wealthy people?
- Is it fair to own life and create monopolies out of it?

An open and engaged ethical debate is needed to discuss on the moral acceptability of these risks, benefits and finally define and decide about the moral grounding which ought to guide policy and regulatory issues in this area.¹⁸

4. CATALOGUE of Social Sciences RESEARCH TOPICS

in Synthetic Biology

IDENTIFY, ASSESS AND MONITOR THE IMPACTS OF SYNTHETIC BIOLOGY

...the social sciences, by using scientific methods and systematic approaches towards understanding phenomena affecting society, can help to provide **assessment, understanding, monitoring and management of scientific development....**

Risks: Safety/security

- Assess and monitor the current state of the technology and its associated risks to make sure the current safety and security measures are suitable (with a special focus to the (DIYbio) community where people conduct biological research outside the normal research environment)
- Identification of new options to enhance biosecurity, foster laboratory safety, and protect the communities and environment outside of laboratories.
- Following up safety/security policy and regulatory frameworks and determine whether the existing regulations are appropriate or if there is need for revised new regulation.

Information sharing / Intellectual property rights

- Analyse if and how property rights might be best applied or modified to support continued innovation in synthetic biology and if appropriate, develop solutions that will facilitate open access and freedom to operate analysis;
- Specifically there is a need to assess and monitor at both national and European level if SB enabling technologies are being affected by IPR constraints. These enabling technologies¹⁹ include public and private registries of biological parts, standard methods for physical assembly of DNA constructs, genomic databases, software tools for search, alignment, analysis, and editing of DNA sequences, and commercial services for DNA synthesis and sequencing.
- Development of appropriate technical activities in support of European harmonization and access to these enabling technologies

Benefits of research / Global justice

- Assessment of the socio-economic impacts of the products and processes developed; development of innovative business models to support global justice;

COMMUNICATION

“Along with synthetic biology’s promises of great impacts on society whether beneficial, spectacular or disturbing, comes the need of a rightly communication...”

... the debate has to start now to avoid a debacle like that surrounding the GMOs, and prevent that sb is seen as an evil that has to be stopped, addressing the fears of a public backlash...

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- Explore, in collaboration with existing frameworks and competences, new and innovative approaches for formal and informal SB public education through science centres, museums, media, or other relevant means, focusing on different publics at different contexts.
 - Explore, in collaboration with existing frameworks and competences, strategies for public engagement and collaborative initiatives, based on an open dialogue and mutual learning, so that the public will be able to effectively contribute to the decision-making process.
 - Explore, strategies to promote a close cooperation between stakeholders with different backgrounds and perspectives, in particularly to those groups that traditionally do not easily cooperate.

ETHICAL AND PHYLOSOFICAL ASPECTS

“The domain of ethics starts when science and technology do far more than providing means for its goals”²⁰

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- Development of educational programmes that will improve the adherence to high ethical standards for good governance in all stages of the research process – funding, planning implementation, application and dissemination.
 - Development of SB adapted methods to address research misconduct by providing guidelines and codes of conduct, suggested by the scientific community as well as governmental structures.
 - Raising awareness of benefits and risks of SB to the general public and develop insights into how ethical issues pertaining to the SB field is being perceived and evaluated by citizens.
 - Develop strategies to engage society to discuss on the moral acceptability of SB risks, benefits, and social impacts, and integrate their opinions and concerns into policy.
 - Philosophical reflections on the status, dignity and conceptions of life

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