ResAGorA
Governance framework for Responsible Research and Innovation

Case Study

Integration of RRI in policy advice – A review of the UK synthetic biology roadmap

Davy van Doren
Fraunhofer Institute for Systems and Innovation Research ISI

Contact: Davy van Doren: Davy.van.Doren@isi.fraunhofer.de

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Introduction

This report builds upon a pilot case study – executed within the Res-AGorA project – which investigated how assessments have been conducted in order to design, review or implement normative frameworks for synthetic biology (van Doren, 2014). A main conclusion of this previous study was that the creation and evaluation of actor transcending frameworks for responsible research and innovation (RRI) has likely been obstructed by both limited availability of empirical evidence and insufficient upstream engagement of relevant actors. The following report provides additional (and more context specific insights) on how RRI has been approached in the development of a synthetic biology roadmap for the UK (Technology Strategy Board, 2012), including what impact such approach has made.

Situation of case study

The institutionalisation of synthetic biology[1] in the UK is mainly driven by BBSRC (Biotechnology and Biological Sciences Research Council) and EPSRC (Engineering and the Physical Sciences Research Council). This institutionalisation, which arguably started around 2007 with the formation of BBSRC's Bioscience for Society Synthetic Biology sub-panel, has resulted in an increasing number of funding schemes, research activities and public reports. The UK synthetic biology roadmap, produced at the request of the UK Department for Business Innovation and Skills, can be considered as a milestone in this development.

Due to the emergent nature of synthetic biology, indications towards the definition and institutionalisation of RRI in synthetic biology are scarce. The UK synthetic biology roadmap explicitly mentions RRI as an important focus. Therefore, focussing on how RRI has been approached in the UK synthetic biology roadmap, this report will address the following three research questions:

- RRI & normative claims: How is RRI described in the UK synthetic biology roadmap, what additional normative claims are made and how are they being legitimised?
- Actor involvement and influence: What actors were involved in conducting the UK synthetic biology roadmap, and how did actor involvement and interaction influence made recommendations and suggested directions for future development?
- Impact of roadmap: What can be observed with respect to the impact of the UK synthetic biology roadmap, and are there indications towards the realisation of RRI in current synthetic biology practice?

Methodological approach

Res-AGorA research heuristic, well-doing & responsibilisation

The research questions are addressed though the operationalization of the Res-AGorA research heuristic (Walhout, Kuhlmann, & Bärbel, 2014), being composed of three elements: *governance arrangements*, *actors* and *de facto RRI practices.* These three elements are here interpreted as follows:

- RRI Governance arrangements in making: A technology roadmap is a plan that matches short- and long-term goals with specific technology solutions for meeting those goals (Garcia & Bray, 1997) and is a tool which can be applied to develop emerging

[1] For an introduction into synthetic biology, see e.g. Elowitz & Lim (2010), Endy (2005), Khalil & Collins (2010) and Serrano (2007).

technologies (Farrukh, Phaal, & Probert, 2003) . An important use of roadmaps is for reaching consensus about a set of needs and the technologies required to satisfy those needs (Laube & Abele, 2005). In this perspective, technology roadmaps can be observed as a form of governance that encapsulates practices in which participating actors work towards legitimate normative objectives and outcomes. This also relates to the argued need for research and innovation processes and achievements to follow particular normative principles, objectives and outcomes (see Kuhlmann, Dorbeck-Jung, & Walhout, 2013).

- Actors involved: A close look is taken at both conducting and involved actors with regard to the UK synthetic biology roadmap. Such review considers initial actor intentions for developing the roadmap, productive and constructive developments that facilitated and influenced the finalisation of the roadmap, and the potential change of actor attitudes and hold normative frameworks with regard to synthetic biology.

- De facto practices of RRI governance: With regard to the purpose of assessing practices and the involved actor landscape, we will determine to what extent the UK synthetic biology roadmap reflects upon the status of RRI in synthetic biology. In addition, we aim to determine to what extent the completion of the roadmap might have initiated new or alternate normative principles, objectives or outcomes in the context of synthetic biology.

In addition, Res-AGorA is interested in the concepts of well-doing and responsibilisation (Walhout et al., 2014). Well-doing relates to how well *de facto* governance is aligned with RRI governance arrangements, resulting from both productive and constructive efforts; responsibilisation is about "*the governance of (self-)stimulating actors to care for their duties […] by drawing on a clear understanding of their responsibilities and un-coerced application of values*" (ibid). Implications derived from this case study in relation to both concepts are discussed in the conclusion.

Source and analysis of data

The data derived within this case study is based on document analysis and stakeholder interviews. The document analysis included *a synthetic biology roadmap for the UK* (Technology Strategy Board, 2012)[2], *The UK government response to the roadmap*[3], the *Synthetic Biology Dialogue* report (Bhattachary, Calitz, & Hunter, 2010)[4] and minutes of the *Synthetic Biology*

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[2] Including the roadmap landscape schematic: https://connect.innovateuk.org/web/synthetic-biology-special-interest-group/roadmap-for-synthetic-biology

[3] See https://www.gov.uk/government/publications/response-to-a-synthetic-biology-roadmap-for-the-uk-letter-from-david-willetts-mp-to-dr-lionel-clarke

[4] Including videos from the launch event; see also http://www.bbsrc.ac.uk/society/dialogue/activities/synthetic-biology/findings-recommendations.aspx

Leadership Council (SBLC)[5]. A number of interviews have been conducted with actors that have been, or still are, involved in the initiatives related to the analysed documents[6].

Results

RRI & normative claims

Focussing on synthetic biology innovation processes in general (i.e. not product- or process-specific) in the UK, the roadmap aims to create a "*... shared synthetic biology roadmap for the UK …*" (although acknowledging the international nature of the synthetic biology domain), to identify and stimulate "*initiatives that will help companies develop new products, processes and services of clear public benefit"*, and "*generate economic growth and create jobs*" (Technology Strategy Board, 2012, p.4). Within this aim, the roadmap prioritises RRI as one of its core themes[7] and to provide directions towards how RRI could be implemented. Although RRI has been introduced in synthetic biology debates relatively early (with regard to its trajectory of techno-scientific development) and has been a circulating topic ever since, relevant literature was not abundant during the development of the roadmap, forcing the coordination group to work mainly with available sources and experiences related to emerging technologies in general[8].

[5] See https://connect.innovateuk.org/web/synthetic-biology-special-interest-group/sblc-meetings

[6] Since all interviews were conducted on an anonymous basis, no specific references towards the identity or affiliation of interviewees are made. Interviews were made with representatives of *scientific/academic organisations*, *public interest bodies (NGO)*, *industry*, and *R&D council & support organisations*. Interviewees were involved in one of the following initiatives/activities: UK Synthetic biology roadmap, UK Synthetic biology dialogue and/or the Synthetic Biology Leadership Council.

[7] In addition to other core themes of (1) foundational science and engineering, (2) developing technology for commercial use, (3) applications and markets, and (4) international cooperation.

[8] Based on interview insights.

The roadmap states that there is a "*... need to continue practising responsible research and innovation at all stages*..." (Technology Strategy Board, 2012, p.19) and that synthetic biology should be developed in a "*... socially responsible fashion*" (Technology Strategy Board, 2012, p.5). It thereby implies that RRI has already been present in synthetic biology practice which should continue to hold up such tradition. Here, it is stated that responsible research and innovation for synthetic biology has three requirements (Technology Strategy Board, 2012, p.21):

1. "... that inescapable uncertainty is acknowledged and measures are put in place to ensure safe, rapid and effective responses to any unforeseen problems...",

2. " ... that the UK maintains and develops its regulatory and enforcement regime for environmental, health and security risks relating to synthetic biology and that it does so from an international perspective...", and

3. "...that 'engagement' means genuinely giving power to a wide range of diverse social groups, including those who will be the end users or presumed beneficiaries of the technologies, taking their concerns seriously, and enabling them to participate throughout the whole pathway of technological development...".

The first two points link RRI strongly to existing and enforced regulatory frameworks. In this perspective, the roadmap states that UK research and development is well placed as it "...is protected and enabled by [...] regulatory frameworks that are recognised around the world as robust and proportionate..." (Technology Strategy Board, 2012, p.9). The roadmap seems to be aligned with several other publications in the field of synthetic biology that regard current regulatory frameworks sufficient for driving synthetic biology research and development (e.g. Erickson, Singh, & Winters, 2011).

In addition to regulation, the third points links RRI more to the social and ethical dimension of synthetic biology. The roadmap states that synthetic biology in the UK "... routinely takes account of social and ethical issues..." (Technology Strategy Board, 2012, p.5). However, it is not clearly stated what, in this respect, is exactly being accounted for. In addition, by recommending participation throughout the whole pathway of technological development, this point indirectly implies an non-necessity to fundamentally question synthetic biology's technological development but highlights a strong focus on driving innovation.

The roadmap places therefore large emphasis on the development and commercialisation aspects of RRI in synthetic biology. This orientation might be partly explained by an expressed belief of RRI practices to be already well established in academic circles, but lacking in industrialisation efforts . As a result, a number of fundamental issues related to synthetic biology and its development – in particular those related to the ethical and social dimension of RRI – are not explicitly or intensely discussed.

With regard to allocation of responsibility, we observe that responsibility is mainly placed on future activities:

- Responsibility is placed on potential future products based on synthetic biology that need to be able to demonstrate "... *clear public benefits*..." or "... *solutions to compelling problems* ..." (Technology Strategy Board, 2012, p.19).
- The roadmap places some responsibility on synthetic biology researchers through helping regulators to optimise existing regulation, or create new, with regard to future synthetic biology developments (Technology Strategy Board, 2012, p.21).
- Social and ethical issues are addressed with regard to future training programmes (Technology Strategy Board, 2012, page 18 & 31).

Actor involvement and influence

Involved actors

The roadmap was compiled by a coordination group, composed of (1) a chairman from industry, (2) members representing a combination of actors active in research, development and market development, and (3) UK government observers (see also Appendix Table 1). The roadmap states that it is " ... *an independent panel ... [that was] set out to reflect a representative view drawn from across the UK community*" (Technology Strategy Board, 2012, page 3).

In addition, the roadmapping procedure included two workshops that were attended by over 70 people (Technology Strategy Board, 2012, page 14). Although the actual composition of the two workshops differed (i.e. the second workshop was attended by different participants compared to the first workshop), it was intended for both workshops to represent stakeholders from industry, academia, regulatory bodies, funding agencies and policy makers[9].

With regard to the coordination group and roadmapping workshops, two observations can be made.

- First, there is similarity between the composition of the coordination group and participation of the workshops. This raises the question to what extent other issues and interests of actors that did not participate have been sufficiently addressed.
- Second, with regard to the output of the two workshops, it seems that the developed landscape is not perfectly aligned with the created vision and its recommendations. With regard to the roadmap landscape schematic, we observe a number

[9] Based on interview insights.

of elements that seem relevant to RRI. In particular, a crucial element in the landscape seems its short-term prioritisation of satisfying public concern. However, this prioritisation is not well established in the vision's recommendations. Although public awareness and concerns are to a certain extent addressed in recommendations with respect to building a UK-wide synthetic biology community (in particular recommendation 2.2 and 2.3), they are lacking in recommendations that address responsible market development (recommendations section 3).

There was little contestation around the proposed text on RRI within the roadmap[10]. However, regarding the specific application of RRI to synthetic biology, potential values and benefits are barely contested in the roadmap. This does not seems to represent the general discussion around synthetic biology, where still issues related to bioethics, biosafety, biosecurity, IPR and public acceptance are debated (e.g. see Schmidt et al., 2009).

In contrast to alternative approaches were contestations are more actively and explicitly deliberated for safeguarding RRI (e.g. see Douglas & Stemerding, 2014), the UK roadmap has chosen an approach that is more focussed on facilitating and driving innovation – implicitly assuming that such facilitation will induce positive externalities for sustainable development and the adoption of required responsibilities: *" ... we consider how to advance synthetic biology technologies so that they are fit for use in a broad range of potential applications and markets. Implicit in this activity is the desire to increase growth in the UK economy, generating wealth and creating jobs, consistent with the ongoing practice of responsible research and innovation..."* (Technology Strategy Board, 2012, p.22).

Excluded actors

It is unclear to what extent other actor types – especially those not directly related to research, development and support of synthetic biology and holding potentially alternative opinions regarding short- and long-term synthetic biology development strategies – have or could have influenced the road-mapping process. Three types of actor involvement that have received prominent attention in synthetic biology debates include (1) public engagement, (2) NGO involvement, and (3) DIY-biology.

1. *Public engagement*: With regard to public engagement, the roadmap refers mainly to the UK synthetic biology public dialogue (Bhattachary et al., 2010). "'Open-door' mechanisms for dialogue" are recommended in the roadmap, by means of multidisciplinary centres, an overarching network, a leadership council (Technology Strategy Board, 2012, p.5) and additional future activities of stakeholder and lay involvement (Technology Strategy Board, 2012, footnote p.34). However, the aims of such actions – including to what extent they could implement, monitor and legitimise RRI – remain

[10] Based on interview insights.

unspecified. Also, it is unclear how – over time – changing perceptions and interpretations by various actors of RRI could be accounted for.

2. *NGO involvement*: Early 2012, Friends of the Earth, CTA and ETC group published a critical report with regard to synthetic biology's potential risks and the need for precautionary principles in regulating synthetic biology (Hoffman, Hanson, & Thomas, 2012), a report that was also endorsed by several UK NGOs. This observation, taking into consideration the potential influence such organisations can have on public awareness and attitudes, seems to stress the importance to include such actors – or at least their concerns – within the process of developing a roadmap. There are no indications that such inclusion was intended or achieved. It is unclear what might have affected this absence, as it could have been caused by a narrow scope of the conducting organisation, as well as by ignorance of – or a lack of prioritisation by – UK NGOs. Despite the considerable critical reflection of various organisations towards synthetic biology globally, the commotion synthetic biology has created among NGOs in the UK has been relatively limited[11].

3. *DIY-biology*: The absent representation of the DIY-biology community[12] has also been mentioned as limiting an open and coherent process of synthetic biology strategy making[13]. Although the role and impact of these communities is still mainly seen as currently marginal, especially in the context of synthetic biology, this might drastically change over time – as observed in ICT's historic trajectory – and therefore seems to necessitate their inclusion and consideration in any strategic effort. The almost exclusive focus on fears might jeopardise public acceptance of DIY-biology and its integration within the overall biotechnology domain[14]. Also with regard to regulation, underlying capabilities of DIY-biology communities to work around legislation[15] would be expected to raise interest.

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[11] Based on interview insights.

[12] With DIY-biology, we refer here to all movements related to the practice of biology and biotechnology outside the professional realm. This includes also activities associated to biohacking and garage-biotechnology.

[13] Based on interview insights.

[14] Based on interview insights.

[15] See e.g. the glowing plant project: http://www.synbiowatch.org/2013/08/diy-synbio-lab-biocurious-questions-glowing-plant-project-propriety-east-bay-express-article/

Impact of roadmap

The impact of the roadmap seems to be quite substantial, at least on the UK national level. The roadmap was well received within the UK government and led to various follow-up actions related to the roadmap recommendations. There has been a boost in synthetic biology related activities in the past 3 years[16], including increased public funding, several transnational collaboration agreements (e.g. with Spain, China and South Korea), installed support mechanisms for the life-science sector, and the prioritisation of synthetic biology as one of UK's eight great technologies (https://www.gov.uk/government/speeches/eight-great-technologies).

Follow-up action on the synthetic biology roadmap seems to be mainly coordinated under the established synthetic biology leadership council (SBLC). Many of the actors of the coordination group are also active in the SBLC (https://connect.innovateuk.org/web/synthetic-biology-special-interest-group/sblc-members). Since the publication of the roadmap in 2012, the SBLC has convened in a series of meetings[17].

Some RRI specific observations[18] here include:

- It was believed that most funding and research focusses on responsible research – rather than responsible innovation – and is heavily driven by public engagement and stakeholder involvement. It was suggested to look how current research programs and other leaderships councils approach the issue of RRI and that the SBLC should only focus on areas that are not already being covered by RRI research (1st meeting Governance Subgroup 2014). However, it is unclear to what extent such coordination has taken place yet.

- The SBLC stated that the synthetic biology community currently self-regulates through a responsible innovation strategy. Activities are planned to support capacity building in responsible innovation. However, according to the synthetic biology dialogue, the public does not approve of self-regulation (Bhattachary et al., 2010).

- Although RRI is explicitly discussed within the SBLC – as an important issue to consider in future development of synthetic biology – it is still not clear under which circumstances its realisation is, or should be, driven. In addition, it is still not obvious to what extent a catalytic reaction might be expected from RRI initiatives or to determine the current magnitude of RRI's realisation in current synthetic biology practices.

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16 Based on search on https://www.gov.uk/

17 Status June 2014: 1 meeting in 2012, 3 meetings in 2013 (3rd meeting was open for observers), 2 meetings in 2014, with upcoming meetings planned. In addition, 1 meeting of a subgroup of the SBLC (Governance sub-group) took place in 2014.

18 Most ongoing activities or planned initiatives related to RRI are managed by the Governance sub-group (https://connect.innovateuk.org/web/synthetic-biology-special-interest-group/governance-sub-group)

- Although RRI was a priority area for the SBLC – as well stressed in the governmental response to the final roadmap – there is no evidence that regulatory frameworks have been recently reviewed, challenged or revised as a result from expressed concerns by academic or market actors.

In addition to observations from the SBLC meetings, some other points related to the impact of the UK synthetic biology roadmap on RRI include:

- Regarding the impact of the roadmap on organisational activity around RRI, the observations differ. Although some organisations might have picked up and implemented the concept of RRI more explicitly as a result of the roadmap (e.g. the TSB now implements RRI components in funding calls and provides an on-going mentoring program; at SynbiCITE, a synthetic biology innovation and knowledge centre, RRI is key and driven through the participation of the BIOS Centre and Innogen Institute (http://synbicite.com/content-panels/responsible-innovation/)), other organisations have shown to address RRI prior the publication of the roadmap (e.g. EPSRC)[19].

- Although some responsibility was placed by the roadmap on synthetic biology researchers and scientists, concrete and specific directions how such responsibility should be put into practice was absent. Such absence makes it difficult to determine to what extent the roadmap might have influenced synthetic biology practices. Due to a lack of incentives, public deliberation regarding pragmatic and specific allocation of actor specific responsibilities have not been found.

Conclusion

With regard to the Res-AGorA research model, the following conclusions can be made:

- *Governance arrangement:* The UK government commissioned the UK synthetic biology roadmap to deliver a shared view and strategy of synthetic biology development in the UK. The roadmap is part of a series of activities – mainly initiated and facilitated by governmental dependent bodies – carried out around synthetic biology in the UK. Based on the impact the roadmap has had so far, the roadmap seems to have been influential in providing strategic developments. RRI is explicitly addressed and well established within the UK synthetic biology domain. Concerning the regarded appropriateness of existing regulatory frameworks relevant to synthetic biology, no need for additional synthetic biology specific regulation was seen.

- *Actors:* The focus on industrialisation of synthetic biology seems to have influenced the balance of represented issues related to RRI – especially those related to its social and

[19] Based on interview insights.

ethical dimension – as certain debates within and outside academic disciplines seem underrepresented in the roadmap's discussion and given recommendations. Due to the focus on market development and driving innovations, input of resources and actors representing different domains (e.g. environment and society) has been limited. Furthermore, it is unclear how actors directly involved in the creation of the roadmap were selected. Finally, the nature and use of input from actors participating in the conducted roadmapping workshops is not clear.

- *De facto RRI practices:* Although RRI is described within the roadmap, it is unclear how the provided description generates and allocates specific responsibilities to various actors involved in synthetic biology research and development. It is unclear how, and to what extent, the roadmap has influenced ongoing practices within synthetic biology – both with regard to techno-scientific development and provided advise to regulators. It is also not evident to what extent actors that are, or could become, involved in the commercialisation of synthetic biology will address RRI as recommended by the roadmap.

With regard to responsibilisation and well-doing, the following conclusion can be made (see also Appendix Table 2):

- *Responsibilisation*: The applied knowledge base for deriving the final roadmap is not transparent. The involvement and influence of external actors is unclear, and indications towards social construction of responsibilities are limited. Due to the focus on future market development, responsibility is mainly placed on future synthetic biology based production processes. With regard to RRI, it is unclear if the roadmap has resulted in alternative synthetic biology practices.

- *Well-doing*: The consideration of contestations present in literature, as well as the presence and management of contestation during the road-mapping process, is not evident. Based on the apparent considerable thrust placed in current regulatory frameworks and academic practices, the roadmap is much oriented towards future market development. Due to such focus, environmental and social indicators seem lacking.

Lessons from case study

With regard to the Res-AGorA research model, lessons from this case study include:

- *Initiation of governance arrangements*: In this case study, RRI was explicitly mentioned as a key topic within the reviewed governance arrangement. However, it is not clear to what extent this prioritisation was commissioned to be included, or was a result of the road-mapping process. Either way, it would be interesting to see how, in which context, or by who, RRI is being placed on the agenda with the aim to become institutionalised. This also relates to literature on institutional entrepreneurship.

- *Modification of governance arrangements*: In this case study, modifications of governance arrangements was not at play. However, it would be interesting to observe to what extent governance arrangement might not only be modified due to the popularisation of RRI, but could cause the emergence and relevance of RRI in itself.

- *Positioning of governance arrangements in the broader context*: This case study shows the influence a governance arrangement can have for the initiation of follow-up arrangements. However, it would also be interesting to analyse how governance arrangements could be inspired by ongoing parallel activities focussing on RRI. For such endeavour, involved actors – including the networks in which they are active – could form an important level of analysis.

- *Normativity regarding emerging technologies*: As synthetic biology is still considered to be in a very early developmental stage, in-depth deliberation regarding perceived normative values might be difficult due to lack of observable impacts and limited empirical knowledge. This could also hinder successful implementation of RRI, since the fluidity of the techno-scientific domain as a whole could lead to short-term restructuration of activities, roles and interdependencies. Such potential phenomenon was also observed in the case study, where no specific responsibilities were defined and allocated on the level of actors.

- *Multi-level analysis (actors & institutions)*: This case study showed indications regarding the influence of actor involvement on made – and followed up – recommendations within the governance arrangement. Therefore, an in-depth analysis of existing power structures, national economic interests and political incentives could provide valuable insights regarding how, and to what extent, RRI is addressed, formulated and implemented within governance.

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Appendix

Table 1: Composition of the UK synthetic biology roadmap coordination group

Sector	Name	Organisation	Description
Chairman			
Industry	Lionel Clarke	Shell	At Shell, Clarke is engaged in strategic research and technology programmes related to biofuels and other biotechnology applications (http://synbiobeta.com/person/lionel-clarke/), including internal resources and external academic and industrial partnerships
Members			
Industry	Joe Adams, Peter Sutton	GlaxoSmithKline	For the company GlaxoSmithKline – an organisation active in researching and developing pharmaceuticals, vaccines and health care services (http://www.gsk.com/about-us/what-we-do.html) – synthetic biology is relevant (http://synbiobeta.com/company/glaxosmithkline/) through its potential to facilitate research and development in medicine

Market development (UK government)	Janet Bainbridge	UK Trade & Investment	UK Trade & Investment is a government department that works with UK based businesses to ensure their success in international markets through exports, as well as to encourage and support overseas companies to settle in the UK (https://www.gov.uk/government/organisations/uk-trade-investment) – also for the domain of synthetic biology (http://synbiobeta.com/company/uk-trade-investment/).
Bioinformatics	Ewan Birney	European Bioinformatics Institute (EBI)	EBI is part of the European Molecular Biology Laboratory (EMBL), which is an intergovernmental organisation specialising in basic research in the life sciences (http://www.embl.de/aboutus/).
	Dek Woolfson	University of Bristol	Dek Woolfson (http://www.bris.ac.uk/chemistry/people/dek-n-woolfson/) has an interest in bioinformatics and biochemistry.
Social science	Jane Calvert	University of Edinburgh	Calvert is active in researching social dimensions of synthetic biology (e.g. see Calvert & Martin, 2009).
	Nikolas Rose, Claire Marris	King's College London	Rose and Marris are active in researching social dimensions of synthetic biology (e.g. see Zhang, Marris, & Rose, 2011).

Bioengineering	Richard Kitney, Paul Freemont	Imperial College, London	Richard Kitney and Paul Freemont from Imperial College London are Co-Directors of the Centre for Synthetic Biology and Innovation. (http://www3.imperial.ac.uk/systemsbiology/groups/syntheticbiology) and active in bioengineering
R&D council & support	Paul Mason	Technology Strategy Board	The Technology Strategy Board is the UK's innovation agency (https://www.innovateuk.org/) and provided the framework for the road-mapping process.
	Amanda Collis (and Andy Boyce – Technical Secretariat)	Biotechnology and Biological Sciences Research Council	The Biotechnology and Biological Sciences Research Council is one (of the in total seven) UK Research Councils – funded by the Government's Department for Business, Innovation and Skills – active in strategic planning, review, consultation, employment and diversity policies, policy and position statements (http://www.bbsrc.ac.uk/organisation/organisation-index.aspx).
	Kedar Pandya, Talit Ghaffar	Engineering and Physical Sciences Research Council	The Engineering and Physical Sciences Research Council is one (of the in total seven) UK Research Councils – funded by the Government's Department for Business, Innovation and Skills – active in strategic planning, review, consultation, employment and diversity policies, policy and position statements (http://www.epsrc.ac.uk/about/Pages/aboutus.aspx).

Observers			
UK government	Ron Egginton, David Uffindell	Department for Business, Innovation and Skills	BIS (Business, Innovation and Skills) department (https://www.gov.uk/government/organisations/department-for-business-innovation-skills)
	Michael Edbury	Government Office for Science	Government Office for Science (https://www.gov.uk/government/organisations/government-office-for-science)

Table 2: Summary regarding responsibilisation and managing contestation

	Constructive (input requirements)	Productive (transformation)
Responsibi-lisation	Actor inclusion: focussed towards market development dimension of synthetic biology Limited/no inclusion of actors representing interests of environment and society Robustness of the knowledge base Knowledge base not completely transparent Use of workshop information not clear Capacities for learning Unclear to what extent learning has been achieved (both within the coordination group and during the executed workshops) Embedding of responsibility Mainly rooted within existing regulatory frameworks and past executed dialogues Social construction of explicit responsibilities seems lacking Responsibility mainly placed on future production and processes based on synthetic biology	Actors change behaviour / attitude in line with new understandings of responsibility Substantial impact of the roadmap on UK national level (governmental support) Certain organisations contain a strong RRI component due to the roadmap exercise. The extensiveness of influence of the roadmap on RRI realisation in general is not evident

Managing contestation	Procedures and 'rules of the game' Unclear how contestations present in literature have been considered within the road-mapping process Transparency Presence, level and management of contestation during the road-mapping process unclear Trust in the de facto governance process Trust in appropriateness of current regulatory frameworks	Governance arrangements align with or are changed towards input requirements (constructive) The roadmap seems much oriented towards market development and driving innovation Limited inclusion of resources – and absence of critical reflection – regarding other dimensions relevant to sustainable development (society and environment)

Towards Anticipatory Governance of Responsible Research and Innovation

The objective of the Res-AGorA project is to develop a comprehensive governance framework for responsible research and innovation (RRI). This will be a contribution to the EU ambition of becoming a genuine Innovation Union by 2020 striving for excellent science, a competitive industry and a better society without compromising on sustainability goals as well as ethically acceptable and socially desirable conditions.

The goal of the Rea-AGorA project will be achieved through extensive case study research about existing RRI governance across different scientific technological areas, continuous monitoring of RRI trends in 16 European countries, and constructive negotiations and deliberation between key stakeholders. This comprehensive empirical work will be the building blocks of the creation of a governance framework for RRI.

The case study summarised in this document is output of Res-AGorA's extensive empirical programme (Work Package 3).

More information at www.res-agora.eu

Contact for Res-AGorA's case study programme (WP3)
Dr. Sally Randles
Manchester Institute of Innovation Research MIoIR
Sally.Randles@mbs.ac.uk

Prof. Dr. Jakob Edler
Manchester Institute of Innovation Research MIoIR
Jakob.Edler@mbs.ac.uk

Res-AGorA Co-ordinator
Prof. Dr. Ralf Lindner
Fraunhofer Institute for Systems and Innovation Research ISI
Ralf.Lindner@isi.fraunhofer.de

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