

Mainstreaming RRI in biosciences and beyond: a quadruple contextualization

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Summary

Science is a part of society and co-evolves with it. However, science-society relationships are deeply changing, and biosciences are at the core of these changes.

Transformations in post-modern societies and in science production pose new governance challenges which RRI, or similar approaches, can certainly contribute to face. This is perhaps all the more true in this period of great emergency related to COVID-19, and will probably also be true in a later period.

STARBIOS2 project experience aimed at producing RRI institutional or “structural” changes in several bioscience organizations. Based on this experience, RRI mainstreaming is suggested, as focused on four levels of “contextualization”: organizational, disciplinary/sectoral, geopolitical/ cultural and historical ones.



Introduction

This text is a strategic document, intended as a tool for reflection within the final phase of the STARBIOS2 project (“Structural Transformation to Attain Responsible BIOSciences”). The project, started on 2016, is coordinated by the University of Rome – Tor Vergata and funded by the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 709517.

During the project, specific Action Plans (APs) were implemented to attain institutional or “structural” changes – i.e., changes that are conceived to be comprehensive, inclusive, contextualized and irreversible –, related to Responsible Research and Innovation (RRI) in six European institutions active in the field of biosciences: Agrobioinstitute (Bulgaria), University of Bremen (Germany), University of Rome Tor Vergata (Italy), University of Primorska (Slovenia), University of Gdańsk (Poland), and University of Oxford (United Kingdom). Moreover Action plans have been also designed and planned in three non-European institutions: FIOCRUZ (Brazil), ICGEB (South Africa) and University System of Maryland (United States).

Based on the APs experience, a learning process was launched for developing a set of Guidelines on the implementation of responsible research and innovation including a sustainable model for RRI in biosciences.

At the conclusion of STARBIOS2, a final event at distance is scheduled to reflect on the meaning, scope and prospects of the actions carried out, on May 29 2020.

This document aims to accompany the final activities of the project, providing a series of elements on the current relationship between science and society, highlighting some issues on responsible research and innovation in the field of biosciences and identifying some challenges for the future.

It should be emphasized that this Strategic Document, essentially focused on some important issues that have been at the core of STARBIOS2 during all its 4 years of activity. However, the text is completed and disseminated in the final months of the project, just as the COVID-19 pandemic is underway. We are therefore aware that this pandemic challenges not only our societies, political systems, economic systems, but also the biosciences themselves, today and in the future, in their ability to play a key public role, to share information and to produce relevant knowledge.

The nature of this document

RRI action plans in 9 research organizations in Biosciences

Final event

Science and society today, open issues, challenges for the future

The challenge of COVID-19

1. Transformations in the relationships between science and society

1.1 A changing society

Science and society are interconnected entities: they have always co-evolved, but this relationship is deeply changing, as part of a broader shift from modern to so-called Post-modern (or Post-industrial, Liquid, Knowledge, etc.) society, which affects in similar ways all social institutions: politics, religion, family, state administration, and the same science. The literature highlights a wide range of phenomena connected to this trend, for instance:

- Globalization produces contrasting and uncontrolled effects of inter-connection, dis-embedding of human relations and growing economic competitiveness
- The previous social “structures” (rules, models of action and relationships, values and beliefs), as well as the mechanisms of social control, weaken strongly, under the pressure of increased capacity and power of individuals to think and act more freely than it was in the past as well as to “build up” their own lives, projects, and identities, thanks also to the opportunities offered by the new communication technologies
- People become more exposed to risks of different kinds (health risks, environmental risks, unemployment, lack of access to social protection and pension schemes), and are increasingly asked to manage their own lives by themselves.
- Great social and cultural diversification within society is produced since it is more difficult to identify homogeneous social groups and classes or dominant behavioural patterns while the same identity of individuals is more unstable, fragmented and inconsistent; all that goes hand in hand with a strong diversification of ideas, initiatives, behaviours and forms of knowledge
- All the traditional boundaries and spheres of life are losing their distinction and boundaries (nature/culture; past/present/future; private/public; professional life/leisure)
- The dominant standards and behavioural patterns regulating social institutions (in fields such as family, transitions to adulthood, life course, employment, etc.) are progressively disappearing. Among the other things, this makes it more difficult to provide services and to ensure social equality.

In this context, we are witnessing the diminishing authority and prestige of all political, religious, even scientific institutions, together with a decline in people's trust towards these institutions. As far as science and research are concerned, a singular paradox is evident: as investments and the capacity of research to address key issues for our societies increase, people's support towards science decreases, which often results in forms of open opposition (see for all the case of no-vax) notwithstanding that our current standard of living heavily depend on scientific and technological advancements.

Relationships between science and society are changing

Globalization, weakening of social structures, risks for people and more

Diminishing authority and prestige of all institutions. Even science is affected



1.2 A science in transformation

Scientific research is also profoundly transforming, experiencing a transition that has been examined and called in various ways (shift from Mode 1 to Mode 2 of scientific production, Post-academic science, Post-normal science, Triple Helix approach, Academic Capitalism, etc.).

Scientific research is transforming:
the “Mode 2”

At the heart of this transformation, in many respects, there is the relationship between research and the society to which it belongs. In this regard, a set of trends occurring at the global level can be observed, concerning the “way” in which science is done. Such trends, in some cases, can generate risks and opportunities for both science and society. For instance:

- The increasing relationship between universities, governments and industries
- The increasing diversity of the sites where research is carried out (even at the grassroots level)
- The tendency to favour stakeholder participation in all research phases
- The emergence of approaches aimed at “open” science to society, such as citizen science
- The diffusion of cooperative practices in scientific production
- The increasing relevance of transdisciplinarity
- The increasing expectation that scientific results have economic, social, and environmental impacts
- The orientation of policy-makers towards enabling, leading and steering the research and innovation process
- The increasingly competitive access to public funds for research
- The growing importance attached to quantitative evaluation systems based on publications, often with distorting effects and questionable results
- The emergence on the international economic and technological scene of actors such as India, China, Brazil, South Africa and others.

In such a framework, the transformations affecting science are often generating a sense of uncertainty about its internal mechanisms and standards, including those related to pivotal aspects like career paths, access to resources, and organisation of the research work, even though new opportunities are also opening up.

Science mechanisms and standards are
changing and this generate stress to
manage

Biosciences are at the crossroads in the relations between science and society, after the so-called “biological revolution” and within the context of the “Fourth Industrial Revolution”, based on a set of “converging technologies” including genetics, robotics, info-digital, neurosciences, nanotechnologies, biotechnologies, and artificial Intelligence. In this new context, more and more knowledge is produced and technological solutions are developed requiring a deeper understanding for what concerns their status, limits, and ethical and social acceptability (take the example, just to name one, of the organoids).

Biosciences are at the core of these
transformations

Moreover, pandemics (such as the outbreak of COVID-19 today), food security, clean energy transition, climate change, are all challenges in which biosciences can play a crucial role, while new legal, ethical, and social questions arise that need to be dealt with.

1.3 The governance of the new science–society relationship

These processes have been running for years, albeit in different ways, managed by decision-makers at the international and European level and by national governments. Various forms of governance have been developed and implemented, over time, to re-establish and harmonize the relationship between scientific and technological research and the rest of society. We can refer here, for example, to European strategies and approaches such as Smart Specialization, Open Innovation, Open Science and Responsible Research and Innovation (see below) as well as those related to specific social aspects of science (such as ethical or gender). We can also recall strategies and approaches developed, under different labels, at the international level and in other regional areas such as, among others, the US NSF “Broader Impacts”, the principles expressed in the Daejon Declaration on Science, technology, and Innovation Policies for the Global and Digital Age, the “Science, Technology and Innovation Strategy for Africa - STISA-2024”, and many other initiatives (e.g., in Brazil) inspired by the UN Sustainable Development Goals.

This process of elaboration and experimentation is going on, in search of increasingly relevant and effective solutions. At the same time, there is a need to encourage the mainstreaming of the most convincing solutions and to root them more deeply and sustainably in the complex fabric of scientific organizations and networks. In this context, the question of the mainstreaming of RRI and its application in the field of biosciences also arises.

Biosciences, as has been said, are a pre-eminent place to see these critical dynamics at work, for the contents of its research and the implemented approaches, for the number of investments made, for the speed with which the discoveries follow one another and for the related need to study its consequences and social impacts.

Many approaches are emerging to manage science/society relationships. RRI is one of them

The need for a mainstreaming of the best solutions



2. Responsible research in the STARBIOS2 experience

Responsible Research and Innovation, launched by the European Commission in 2011, is the result of widespread international awareness of the relationship between science and society and can be considered a policy reaction, among others, to this complex transition. In short, it can be interpreted as a way to actually move from the model of science as an “ivory tower” isolated from the rest of society to a more open model. It could provide the basis for a governance system of science and innovation able to face the critical situation caused by the increased importance of S&T to society, providing strategies, measures, rules, participatory practices, knowledge and tools allowing research organizations to better manage the complex changes affecting science and innovation and to prevent, as far as possible, obstacles and jams hindering better and deeper relationships between research and society.

This process towards more intense relations between scientific research and society is already taking place, in one way or another (see point 1.2.). Therefore, an approach such as RRI is not simply ethically recommendable, but indispensable for attempting a re-alignment between scientific research and the needs of society. This effort is focused on six RRI keys (Science education, Gender equality, Public engagement, Ethics, Open access, in addition to the transversal one of Governance) which can be considered as areas of the life of scientific communities in which the criticalities or the most crucial aspects of science-society relations are more evident; and is based on four RRI dimensions (anticipation, inclusiveness, responsiveness, and reflexivity) which provide useful orientations for activating and driving institutional change processes in research organisations and research systems.

The STARBIOS2 project has been conducted in a group of research organizations, active in the biosciences sector, and operating in different geopolitical and cultural contexts (Europe, US, Brazil, South Africa), in order to promote institutional, or structural, changes related to the application of the RRI, according to its various keys (see the box on page 7).

RRI as the core of a governance system to improve relationships between research and society

The RRI keys as areas where the criticalities are more evident

The institutional changes promoted within STARBIOS2 project

Institutional changes: examples from STARBIOS2

As an example, some changes, among those produced or in progress, promoted by STARBIOS2, divided by the 5 RRI keys, can be mentioned.

Science education

- A unified educational study programme for all faculties covering a social responsibility module, within the framework of the “Development programme of University of Gdańsk (ProUG)” project (University of Gdańsk)
- Design of training modules on RRI-related issues for PhD students and Post Doc researchers (University of Primorska, Koper)
- Professional training for young plant biotechnologists “Capacity building for moral judgement and research integrity in ABI” (Agrobiointitute, Sofia)
- Educational modules on nanotechnology, stem cell donation, molecular biology and ecology (biodiversity loss and climate change) are reported/offered at the website of the outreach lab Backstage Science (BaSci Lab Biology) (University of Bremen)

Gender equality

- New gender-related standards in publications and monitoring systems within the research organization (University of Oxford)
- Introduction of gender issues in University courses and in the interdisciplinary lessons promoted by the University Committee for Sustainable Development (e.g. Master in gender medicine 2019-2020) (University of Bremen)
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- Kindergarten, as a tool of the strengthening career planning support programme (University of Gdańsk)
- Family Room offered by the Institute of Science Education (University of Bremen)

Public engagement

- Involvement of the interdisciplinary Graduate School on Nanocompetence and the outreach lab Backstage Science as platforms for discussion about innovation (University of Bremen)
- Creation of a start-up to connect the university research to enterprise: “InNutRes” (Responsible Innovation in Nutrition) (University of Rome Tor Vergata)

Ethics

- Preparation and improvement of the Code of Conduct for biology (CCB) (University of Primorska, Koper)
- The transformation of UNESCO chair in Biotechnology in the Interdisciplinary Chair in “Biotechnology and Sustainable Development” (University of Rome Tor Vergata)

Open access

- Implementation of the Open Access Policy at University of Gdańsk (OAP) and appointed a position of the Rector’s Representative for the Open Access for publications and research results (University of Gdańsk)
- Establishment of a working group for Open Access policy (University of Primorska, Koper)

Full RRI package

- The establishment of a Plant Biotechnology Information Centre aimed at promoting societal engagement and science communication around emerging research, ethical, and societal issues and the establishment of contacts with public institutions and non-governmental organisations (Agrobiointitute, Sofia)
- Booklet of RRI Recommendations for the Faculty Biology /Chemistry: “Towards a sustainable and open science. Enhancing responsible in the biosciences at the University of Bremen”, including suggestions related to the 5 RRI keys (University of Bremen)

Further Action Plans have been drafted by the three STARBIOS2 International partners, i.e., ICGB (South Africa), University of Maryland (USA) and FIOCRUZ (Brazil), touching issues like science dissemination, technology transfer and management of epidemics.



The building blocks of the institutional or structural change activation in research organizations are as follows: the creation of a Core team (in charge of the implementation of the AP); a Context analysis; a Detailed action plan; Stakeholders mobilisation (involving interested individuals, groups or networks); Negotiation processes within organizations and with all stakeholders; Structural impacts and reactions to manage; Self-reflexivity (to be well aware of objectives, obstacles, timelines, opportunities, facilitating factors and risks); Technical assistance and monitoring/assessment, provided by special teams.

The latter aspects were particularly important. Indeed, in biosciences and other contexts characterised by high levels of uncertainty, innovation and social complexity, institutional change processes rarely assume a linear trajectory. Rather, they tend to be nonlinear, characterised by stops and starts, sudden progress and setbacks, unplanned solutions and deviations from the original plan. As a corollary, the implementation phase require pro-activity, flexibility and the capacity to react rapidly to unexpected situations.

3. Some challenges for RRI mainstreaming

As mentioned above, some fundamental aspects of the complex relationship between science and society have been interpreted for years, in various ways and with different labels. One of them is Responsible Research and Innovation. At this point, it is appropriate to ask whether the time has not come to try to extend, as much as possible, the results of many years of research and experimentations on this topic to all the components and sectors of scientific research and innovation.

In this regard, based on the experience of STARBIOS2, some considerations can be made about the mainstreaming of RRI and similar approaches, on which to reason for the future of European policies. Of course, the project focused on biosciences, but perhaps such considerations may make sense for other areas of scientific research as well.

So, how to mainstream Responsible Research and Innovation, or other approaches dealing with a stronger relationship between science and society? One of the fundamental elements of RRI as emerged from the STABIOS2 practice as well as from other similar initiatives is that there is no rigid and universal model, adaptable anytime and anywhere. Although RRI is characterized as a whole by specific elements, formalized over time, it has an intrinsically “contextual” character. Perhaps this can represent, in some ways paradoxically, a useful starting point for mainstreaming.

STARBIOS2 approach

Managing the complexity of implementation processes

How to mainstream RRI and similar approaches?

RRI is “contextual” in nature

In fact, in order to speak of effective mainstreaming, it is necessary to ask whether RRI should be promoted and supported by specific policies, according to four contextualization levels:

Mainstreaming according 4 contextualization levels

- Organizational contextualization
- Disciplinary or sectoral contextualization
- Geopolitical and cultural contextualization
- Historical contextualization.

In each of these levels, we can further identify (by way of example) some “frames of responsibility”, that is, issues at stake on which to exercise forms of shared governance.

Stakes or “frames of responsibility” for governance

3.1 Organizational contextualization

In the case of the organizational contextualisation, mainstreaming takes place through the promotion of a greater embedment of RRI, or similar approaches, within the individual research organizations (universities, national institutes, private centres, etc.). The experience of STARBIOS2 as a whole has highlighted that RRI makes sense only if it is useful for carrying out better research and innovation and for providing solutions to the problems related to the professional life of the various actors within the organization. This means, in any case, going beyond the “business as usual”, and the embedment process is not automatic.

Rooting RRI within the individual research organizations

From this point of view, the research actors who intend to apply and adapt RRI to specific organizational contexts, are confronted with a set of issues that may concern, for example:

- The necessary definition of a vision of research contents (during this definition, aspects of responsible research may emerge e.g., concerning the ways in which sex and gender variables or ethical issues are managed, or research questions are identified)
- The identification of the stages of the research process in which RRI practices should come into play, thus reframing in some way these same stages (e.g., the search for funds and definition of research projects; the definition of research protocols; the experiments and their results; the prototyping process; the identification of possible users of the research outputs, etc.)
- The identification of the aspects of the organisational structure that have to be affected, in order to make the RRI-oriented change structural (e.g., its culture and research agency, the action done, the capacity to pursue the established objectives, through the mobilisation of human and material resources)
- The formalization of the concrete steps to take for implementing an RRI strategy or model. In the STARBIOS2 experience this was formalized in a self-reflection process including: self-positioning within the networks of scientific, economic and political relations; engaging and mobilizing both internal and external key actors; analyzing and choosing the problems to work on; deciding “what” to change (e.g., elements of organisational rules, roles and routines, support to particular categories, such as young researchers, aspects of the organisation's mission or groups' research visions, etc.).





3.2 Disciplinary or sectoral contextualization

This type of mainstreaming consists in adapting the responsible research and innovation approach to a specific discipline (for example biotechnology) or to an entire “sector” in a broad sense, such as that of biosciences.

Adapting RRI to a specific discipline or sector

All the points listed in paragraph 3.1. above have been developed by STARBIOS2 with reference to bioscience organizations, but can also be applied in other disciplinary areas. There are, however, specific points related to individual disciplines or disciplinary sectors. In the case of biosciences, for example, they can be, among others:

- The identification of potential social, economic and cultural impacts of the new biological research and innovation waves and related open ethical issues
- The effective adoption of a multidisciplinary approach, with the consequent changes of professional models, operational and organizational routines, career paths, educational programs, etc.
- The full exploitation of potentials of data sharing (e.g., in the field of pandemics and other global health phenomena)
- The introduction of gender (and other RRI) variables in biological research.

3.3 Geopolitical and cultural contextualization

A further level of RRI mainstreaming aims to identify forms of adaptation, or rather reshaping, of this approach in the various geopolitical and cultural contexts.

RRI re-creation in different geopolitical and cultural contexts

In this regard, examples of possible factors may be:

- The features of the national research system, intellectual property, regulations, etc.
- The economic structure of the country and the relations between research and industry”
- The role of local philosophies and cultures (consider, for example, the inspirational role of the community philosophy of Ubuntu in the world of South African research)
- The use of traditional knowledge in research and innovation (for example in the field of pharmacopoeia and botany) and the related patent and intellectual property rights issues

3.4 Historical contextualization

Another level of RRI mainstreaming is related to the ability of science to respond to the challenges that history poses from time to time (and of which the COVID-19 pandemic is only the last, serious example) and to prevent them as much as possible.

Making sciences able to respond to the challenges that history poses and to prevent them

In this regard, many critical issues for governance can be identified, including, for example:

- The construction or re-construction of public trust in science and scientists
- The link between research results and decision-making
- The forms of exchange and evaluation of information and knowledge
- The decisions related to the allocation of research funds
- The mobilization of the different generations and categories of researchers
- The creation of increasingly adequate channels and methods of communication with other sectors of society and with the general public.

3.5 Conclusions

Various types of actors can play a major role in these four levels of mainstreaming of responsible research, including the components of research organisations (scientists, managers, technical-administrative staffs, students, etc.) and other external players (companies, citizens associations, local governments, etc.), up to the funding bodies and decision-makers.

National, European and international policies are called to support the contextualization of RRI and the actors involved in it, to manage and drive in an effective and sustainable way the increasingly intense and widespread relations linking science to society.

This is perhaps all the more true in this period of great emergency, and will probably also be true in a later period, in which it is easy to foresee profound, but still unknown, transformations in our societies, and in which the role of biosciences will be increasingly crucial.

A challenge for the policies:
supporting the 4 contextualizations

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For some insights

Bijker, W.E. & d'Andrea, L. (eds.) (2009). *Handbook on the Socialisation of Scientific and Technological Research, Social Sciences and European Research Capacities*, Rome: River Press Group.

Clarke, L.J., & Kitney, R.I. (2016). Synthetic biology in the UK—an outline of plans and progress. *Synthetic and systems biotechnology*, 1(4), (<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5625736/>) (accessed on: 18/07/2019).

ESFRI European Strategy Forum on Research Infrastructures (2006), Roadmap for European Research Infrastructure. Report of the Biology and Medical Science. Roadmap Working Group, October 2006, https://ec.europa.eu/research/infrastructures/pdf/esfri/esfri_roadmap/roadmap_2006/bms-report-roadmap-wg-2006_en.pdf (accessed on: 05/09/2019).

Nowotny, H., Scott, P., Gibbons, M., & Scott, P.B. (2001). *Re-thinking science: Knowledge and the public in an age of uncertainty*. Cambridge: Polity.

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy*, 42(9).

The STARBIOS2 Guideline and Model: <https://starbios2.eu/2019/starbios2-guidelines-on-rri-implementation-in-bioscience-organisations/>