RESPONSIBLE BIOSCIENCES

A Manifesto for the Transformation of Science-Society Relations

ResBios Project

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This Manifesto is rooted in the work that, for several years now, some research organizations in the field of biosciences in Europe, Africa, and North and South America have been carrying out on issues concerning the relationship between scientific research and society by using the Responsible Research & Innovation (RRI) approach, initially through the STARBIOS2 project and, most recently, in the context of the ResBios project.

This Manifesto is one of the end products of the ResBios project (RESponsible research and innovation grounding practices in BIOSciencies), funded by the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 872146. The project aimed to further develop and embed practices of responsible research and innovation (RRI) in bioscience organisations. This took place through the implementation of 15 RRI Grounding Actions, to achieve sustainable institutional changes in four research organizations in Croatia, Greece, Spain, and Ukraine, supported by technical assistance, communication, evaluation, and mutual learning actions. An International Network for Responsible Biosciences has been launched too.

The ResBios consortium partners are: University of Rome - Tor Vergata (Italy, Coordinator), Aarhus University (Denmark), Agrobioinstitute (Bulgaria), Consejo Superior de Investigaciones Científicas (Spain), Democritus University of Thrace - Department of Molecular Biology and Genetics (Greece), European Science Engagement Association (Germany), Knowledge & Innovation Srls (Italy), University of Lviv - Department of Biochemistry (Ukraine), University of Bremen (Germany), Univerza na Primorsken – Università del Litorale (Slovenia), Zagreb University - Faculty of Agriculture (Croatia), University of Gdansk (Poland).

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Responsibility is a concept increasingly used to refer to the ethical aspect of doing research and innovation. In this Manifesto, responsibility is elaborated as a concept broader in scope and impact, i.e., as a concept to guide institutional practices for better managing current transformations in science and science-society relationships. These transformations are, at the same time, promising and risky. Responsibility, as presented in this Manifesto, allows for better balancing between sustainability and profitability, between goal-focused and curiosity-driven research, and between open science and market-driven science. Academic research and industrial research are now intimately intertwined, and one depends on the other now. Thus, responsibility does not only concern research institutions or universities but also involves a myriad of actors turning around research and innovation, including private companies. Though this Manifesto is relevant for all scientific and scholarly research, it primarily draws on experiences in the biosciences.

This Manifesto is one of the end products of the ResBios project, which was aimed at further developing and embedding practices of responsible research and innovation (RRI) in bioscience organisations.

Biosciences as an exemplary case

Biosciences are particularly suitable for elaborating a new concept of responsibility, for different reasons.

A great responsibility

Biosciences are not only concerned with the study of living organisms but increasingly also with their intentional modification to pursue a wide range of medical, social, or economic goals. Thus, a more significant impact on society is looked for through biosciences. However, biosciences are also increasingly engaged to measure and even manage the impact of social life on the biological dimension. Discoveries in the field of epigenetics show how many social and lifestyle factors (obesity, tobacco or alcohol consumption, environmental pollutants, work environment, psychological stress) can alter epigenetic patterns. All this shows how deeply biosciences are implicated in society and how great their 'responsibility' is in ensuring human well-being.

The crucial role of biosciences

Directly or indirectly, biosciences play a decisive role in many of the challenges facing contemporary societies, such as protecting the environment and fighting climate change, producing food for all, managing the ageing population, developing new materials, preventing and managing pandemics, struggling against cancer, obesity, and chronic diseases, preserving biodiversity, or protecting the soil. The future of many productive sectors (agriculture, animal husbandry, pharmaceutical industry, food industry, etc.) depends largely on bioscience research and the weight of the bio-economy – the goods and services produced using biological knowledge, resources, processes, and methods – is dramatically increasing.

Not surprisingly, investment in biosciences is huge. For example, the funds spent by the U.S. government on life sciences research during 2016-2020, were two and a half times those spent on engineering research, four and a half times those spent on physical sciences, and eight and a half times those spent on computer sciences and mathematics. Although research in the life sciences is much more expensive than in other areas, and laboratory activities usually require more time than is needed in many other research areas, the level of investment shows that society relies on biosciences to address its problems and find new opportunities for development. Data of this type are not available for European funds (due to the different organisation of statistical data) but everything suggests that similar trends are occurring.

Big investments but …

Partly because of their growing relevance, biosciences are exposed to strong social and political pressure and are more involved than other research sectors in the complex changes that are affecting science and the relationship between science and society.

… big challenges too

Biosciences have become a field characterized by hyper-competition, with strong epistemic, organizational, and social consequences. There has been a huge demand for young researchers, without a proportional growth of permanent positions, with the effect of expelling hundreds of researchers from the research circuit after enduring10-15 years of temporary contracts during which, they had hoped to find a position that matched their education and expectations. Indeed, the science system is sometimes referred to as a "PhD factory", especially in the life sciences. Competition is also likely to affect many aspects of the research process, including:

- The evaluation systems (the race to publish in "high impact" journals is overshadowing the intrinsic quality and originality of publications)
- The replicability of data produced in the laboratory (it is estimated that, in all research fields, approximately 50% of all research data and experiments are not considered replicable, but in some areas of life sciences – for example, in research on certain cancer types – the level of non-replicability of data may be even higher)
- The research strategies adopted by researchers (the high level of competition prompts them not to engage in long-term projects with very uncertain results and to write redundant papers or to republish multiple papers).

It is also important to highlight that the biosciences are also a sector in which, more than anywhere else, the question of responsible science has arisen and new approaches, practices and solutions have been developed. Biosciences were among the first sectors in which ethical issues were systematically addressed (and now bioethics is a consolidated branch of biosciences) and in which the issue of social

A pioneering role

acceptance of scientific products and technologies (for example, biotechnologies) was seriously considered.

This is probably due to the fact that bioscience research has a strong, multilayered and diversified impact on the relations between science and society: for example, on social inequality, gender equality, cultural orientation, social values, and behavioral patterns, but also and above all on stakeholders' and people's expectations and their trust in science. Hence the need for researchers and research institutes to "position" themselves precisely in their specific research field in order to understand what responsibility means for them.

In this sense, biosciences can play a pioneering role in embedding responsibility-related principles and practices in science.

Background

Any social institution is an attempt to preserve and develop societal functions that often are more or less intangible. Political institutions for democracy; legal institutions for justice; state institutions for wellbeing and equality; research institutions for knowledge. These institutions and their intangible functions in society are grounded in myths and traditions and sustained over time by rituals. In the case of science, the link between this social institution and its function as knowledge producer is grounded in an ideal-typical scientific method and sustained by varied, though widely, recognised procedures.

A social contract between science and society

Social institutions typically are flawed and perform their functions only partially. Moreover, both social institutions and the intangible functions they are meant to perform change gradually with changing societal conditions, and so do the various relationships between these social institutions and their societal functions. The concept of 'social contract' is often used to describe a relatively stable social institution *cum* societal function by specifying under which conditions the social institution has the legitimacy to perform its function. This concept has been also applied to describe the relations between science and society.

The old social contract …

The old social contract for science, which characterized the science-society relationship from the 19th century to the 1960s, can be traced back to the Humboldtian ideal of university education and to the vision of science spurring innovation by Vannevar Bush, a US presidential adviser. The Humboldtian model of higher education is mostly known for stressing the unity of research and teaching: both can and should be done within one institution, the university. These

scientist-teachers have a high degree of autonomy. Vannevar Bush, in his 1945 report *Science, The Endless Frontier*, also stresses the autonomy of science. He presents a linear model of fundamental research–applied research–technological development–innovation. Bush's version of the social contract, then, states that if society funds basic science, science will in due time deliver innovations and wealth to society. Central elements in the old social contract for science thus are the autonomy of science and the state funding for science. Science is expected to deliver a steady stream of innovations, but there is no detailed accounting of those results. Additional elements are implied, for example, the choice of research topics: the research agenda is decided by scientists and without state interference. Quality control of science is done internally within science by peer review. And most scientific research is done in universities and is mono-disciplinary. This style of doing science has also been labelled 'mode-1 science'.

... and its crises

This social contract of an autonomous science that is delivering public goods to society has been crumbling since the 1960s. The autonomy of science has eroded since budget constraints and international competition prompted governments to set national research priorities and to make research funding conditional on delivering specific results. Moreover, much more research has been carried out outside universities, in semi-public and private institutions, and in big corporate industries. Scientific research now is often multi-, inter- and trans-disciplinary. Nowotny and colleagues (2001) characterized this as a shift to 'mode-2 science'. This shift from modern to late-modern society (sometimes called 'risk society', 'information society', 'network society', etc.), is making the old social contract no longer applicable, and even increasingly dysfunctional.

Two factors underlying these crises:

Very roughly, two factors can be considered to underlie the crisis of the old social contract about science: social variability and the weakening of social structures.

Social variability

Social variability is the result of societal changes, in which ordinary people have increasingly enjoyed opportunities and inputs – more social protection, more rights, more access to powerful technologies, more education, more information, more opportunities to establish social ties, more mobility, more goods and services, more health. This huge empowerment progressively allowed people to influence the development of society, and to manage their own life relatively freely. Moreover, and especially during the last 50 years, this led to a society no longer made up of recognisable social pillars and layers, and hence more difficult to rule and more uncertain to live in. Consequently, people's cognitive (ideas, opinions, beliefs) and emotional (sentiments, fears, aspirations) characteristics have become increasingly important in both the public and personal sphere.

The weakening of social structures is the main consequence of this process. Variability implies that any dominant pattern (of values, beliefs, behaviours, hierarchal relations, etc.) can be and indeed is questioned, rejected, or simply ignored – the authority of the social institutions in which these social structures are embedded is continuously being challenged. Any social structure is at the same time constraining and enabling. Thus, the weakening of social structures reduces the constraining components, but also the enabling components, thus leading individuals to be more autonomous but also more uncertain about their choices and more exposed to risks. This is psychologically stressful.

... and the weakening of social structures

As for science, the special status of scientific knowledge is now often questioned and relativised by reference to other forms of socially embedded knowledge. In all this, even the very possibility of practising the scientific method correctly could be at stake. Alternative sources of authoritative knowledge are increasingly sought by individuals. It is worth noticing that these changes are not only influencing science from the outside but are also occurring inside scientific institutions. Therefore, there is not only a problem of socialising science in a changing society but also one of internally organising science in a different way.

Impact on science

This does not mean that the old contract is already crumbled down. Rather, it means that new arrangements and practices have emerged that relate science and society to each other in novel and promising ways. These new arrangements could already be seen as elements of a new social contract between science and society. And perhaps the Covid-19 pandemic has provided a further push, especially in the case of biosciences. A new social contract should lead to institutional changes, thus translating the novel arrangements and practices into stable organisational arrangements.

Seeds of change

Elements for a new social contract between science and society

A new social contract is needed to ensure that social institutions on which science is based can keep producing certified knowledge under changed societal conditions. This is even more true since there is no widespread perception of the weakness of science (while there is, for example, of the weakness of politics or the weakness of the welfare state). A reflection on a new social contract should start from the recognition that science is in a transitional phase. Many trends have emerged in the last 70 years (see discussions on mode1 → mode2 change, post-academic science, etc.).

Three trends to start from

Three trends in science-society relations are relevant to rethinking the social contract between science and society.

The first is ***openness***. Reversing the idea of 'autonomy of science' as in the old social contract, scientific institutions are now asked to be open and responsive to society in different ways and levels - to be transparent about accounting for the funding they receive; to communicate and make freely available their results; to work with other societal actors; to combine scientific knowledge with other kinds of knowledge in transdisciplinary work.

1. Openness

The second is ***usefulness***. Rather than unconditioned public support for science as in the old contract, now public support is often given while expecting science to produce marketable or socially applicable knowledge. This led to highly competitive science-driven global markets with stronger involvement of the private sector, increased political steering of research systems, and new criteria to assess research quality, for example in terms of relevance and economic potential. Moreover, the relationship between fundamental and applied research has changed, multidisciplinary, interdisciplinary and transdisciplinary research has increased, and the role of scientists as experts has changed.

2. Usefulness

The third trend is ***the changing organisation*** of scientific institutions. Under the pressure of the trends of increased openness and usefulness, the autonomous community of peers is now becoming a sort of factory, hierarchically organised with few in a tenure (track) position and many with uncertain, temporary contracts. Due to the weakening of research institutions and a limited number of permanent positions, many researchers are freelancers competing with each other while trying to access permanent positions and acquire scientific credits. The sense of belonging to one's organisation is fading away.

3. Reorganisation of scientific institutions

All this is also affecting the most intimate mechanisms of scientific production. Together, these trends provide a composite picture of the changes affecting science – some promising and others problematic.

A composite picture

Some trends, such as openness, are to be supported and institutionalised at a global level. The disciplinary structure of science should be revised, supporting a new balance between disciplinary specialisation and interdisciplinary and transdisciplinary collaboration. However, other trends should be better managed or partially redressed, not least because they present risks to science itself. The organizational changes of the scientific work were aimed at increasing its efficiency. Still, they also ended up producing a waste of time and ideas (for example in the form of failed funding proposals), psychological suffering of researchers, overexploitation of young researchers, and redundant science. A new social contract between science and society should improve the ways in which the social institution of science keeps control over its internal processes and products

while supporting newly evolving relations with society and the usefulness of the knowledge produced.

Science and societal challenges

For such a new social contract, some examples can already be identified. One is that countries now quite explicitly formulate the societal challenges which their research must help to address, and then organize their research accordingly. The European Union's Framework Programs have had this characteristic from their very beginning in 1984. Non-state groups have raised these questions too. In 2009, for example, Indian and African activists and researchers asked what kind of research India and Africa would need for their own development: what research agenda could be formulated in Indian and African terms, rather than awaiting global (i.e., mostly 'Western') science to supposedly, automatically benefit India and Africa This resulted in two manifestos for Indian and African science. The Dutch National Research Agenda (NWA) is another recent example, where all citizens were invited to engage with science's research agenda. The government budgeted 100M euro per year for the execution of that research agenda. In New Zealand, with another approach, a campaign was launched that aimed to foster public engagement in research agenda-setting, especially for the new national science program (2013-22), the National Science Challenges. The project (called "The Great New Zealand Science Project - GNZSP") facilitated nationwide communication and discussion about the biggest scientific issues facing the country.

RRI and beyond

Another example of involving society in science – and thus promoting a change in the old social contract between science and society – is Responsible Research and Innovation (RRI). Four dimensions summarize the thrust of RRI: it requires *anticipation* of the future societies that we wish for, *reflexivity* by researchers and innovators on the effects of their work, the *inclusion* of relevant stakeholders, and *responsiveness* to the needs and ambitions of society as well as to the intermediate research results. For policy purposes, this is often translated into the six RRI 'key' areas of the science-society relationship: public engagement, gender, education, open access, ethics, and research governance. Over time, the reflection on responsibility in science has also led in Europe to a more significant investment in and a better understanding of the complex relationships between science and society, no longer grasping them as opposing entities ("science and society") but interpreting the former as fully incorporated, for good and for evil, in the latter ("science with and for society").

One implication of RRI – and of three decades of work in STS (Science, Technology & Society studies) and approaches such as Open Science, Citizen Science, Broader Impact, etc. – is that also knowledge provided by non-scientists (in the sense of not being trained in universities) is valued. This is the basis for the involvement in research and innovation programs of actors in the so-called 'quadruple helix'

(university-industry-government-public), and for collaboration between researchers and citizens in numerous experiences all over the world (e.g., citizen participation in research on the Zika pandemic in Brazil; citizen forums for reforestation programs in Indonesia; numerous European and Northern Americans projects involving citizens in fields such as nature conservation, archaeology and astronomy; the involvement of fishermen and divers in the conservation of the environment in South Africa).

Science in the Covid-19 pandemic

The Covid-19 pandemic has demonstrated the necessity for a new social contract between science and society. The pandemic revealed how crucial the role of science and technology is in our societies – without globalisation and its transportation technologies, the Coronavirus would not have travelled so far and fast, and without virology, epidemiology, and social sciences, the devastation would have been even larger. The pandemic also showed that a new contract between science and society is possible. The pandemic demonstrated the benefits of a relatively new role for science: prominent, substantive, based on integrity and transparency t and broadly accepted. Science took a relatively important function in shaping public health policies to contain the pandemic. Scientists did not hesitate to present substantive content, explaining technical concepts, and highlighting the uncertainty of much of the data and the lack of knowledge about this virus. The making of scientific advice was transparent, for example by publishing the background of the scientists on the advisory committees and citing relevant scientific literature. Scientists, in most cases, limited themselves to an advisory role and refused to be pushed into a policy-making role.

Competition and responsibility: two legs for science to walk

A new social contract will not be easy to introduce without tensions. The element of 'society setting a research agenda' does not imply, for example, stopping all fundamental research. Such fundamental research, only guided by scientists' curiosity, has produced many of the current insights and innovations on which our societies thrive. A mix of society-driven and curiosity-driven research, possibly different for each country, is advisable. For example, the importance to integrate patients' knowledge is increasingly recognised in medical research. However, this entails the development of new scientific procedures that allow taking patients' knowledge seriously and dealing with it effectively. Otherwise, there is a risk that tensions will arise regarding, for example, the prominent role of scientific knowledge or the value of the knowledge of laypeople. There is no easy solution. Researchers, activists, and citizens: all need to strike a balance between confidence in one's own expertise and modesty when listening to others who speak from another knowledge system.

The trends that were identified at the beginning of this section are all fuelled by increased competition over the past decades (see also the second section on

biosciences). The new elements for a social contract that we discussed towards the end of this section, however, ask for something else. To this end, we will elaborate the idea of responsibility. Can we imagine science as a body moving on two legs – competition and responsibility – rather than limping on only one?

A new conception of responsibility

An extended concept of responsibility

Responsibility in science is primarily viewed from an ethical angle. This perspective is pivotal when it comes to dealing with aspects like, e.g., protecting the rights of research participants or the treatment of animals in medical research. Still, it is difficult to apply to promote and manage change in research organisations and at a system level. Therefore, we need to develop an extended concept of responsibility that, beyond dealing with issues like research integrity, freedom of research or transparency, could serve as a principle that reduces the negative impact of competition and equips science for better managing science-society relations. Competition fuels and feeds on the 'individual success' (of researchers and research organisations. In doing so, it undermines the advancement of science as a collective and universal endeavour. It undermines the CUDOS values of science as described by Robert Merton[1]. *Responsibility* goes in the opposite direction. It could provide the means, approaches, procedures, and practices to maintain the CUDOS values of science and to restore science's collective and social dimension in a social context drastically different from that in which these values and this dimension were shaped; for example, in a social context where it is difficult to initiate collective initiatives or identify common values.

A new grammar for responsibility

To employ this new, extended concept of 'responsibility', we also need a new grammar of responsibility. Such grammar would specify how the concept can be used and how to prevent ambiguous and confusing usage. A grammar of responsibility would answer questions such as: Who should be responsible? Who should be held responsible? Responsible for what? Can someone be made responsible? What criteria exist for assessing responsibility? How can an organisation act responsibly? And what does the 'who' in these questions denote: individual humans, or also organisations, or even systems and cultures? This Manifesto will develop such a grammar, in tandem with the semantics of this extended concept of responsibility.

Individual responsibility

Because of the weakening of organisations as hierarchical structures, there is a tendency to individualise responsibility. Many experiences of responsibility in science are located at the level of individuals or small groups of researchers. These

[1] Communism, Universalism, Disinterestedness, Organized Scepticism

experiences allowed for testing various ways of managing science-society relationships on a small scale. These experiences sometimes result in activating bottom-up processes. Such forms of responsibility-based collective action can be found in academia, civil society, the private sector, education, etc. Hence the many guidelines, codes of conduct, handbooks, best-practice collections, tips and tricks for questions related to responsibility in science. All these are primarily based on the idea that responsibility is an individual's matter: individual researchers are directly responsible for their research outputs.

Institutional support

However, individual actions are inevitably limited in scope and effectiveness, especially if they are only based on voluntary action (as it often occurs now) without institutional support and recognition. It is unfair and unrealistic to expect individual researchers to anticipate the future impacts of their research, involve stakeholders, communicate with the public, identify ethical issues, and so on all by themselves. Individualising responsibility can only result in a rather limited form of responsibility. But purely top-down approaches do not work either. Due to their weakness, contemporary organisations have a limited ability to impose themselves on staff and withstand the systemic pressure of the competitive globalized research environment. So, a top-down approach and a bottom-up approach to responsibility need to be integrated.

Ingraining responsibility in global science

One of the lessons that we can draw from the many RRI projects promoted in Europe is that measures of enhancing responsibility are localised policies – that locally introduce new processes for responsible research in research institutions. Hence these processes often meet resistance from researchers, since many aspects of responsibility – except perhaps open access and ethics – have not been traditionally embedded in the global mechanisms of research and are perceived by researchers simply as time-consuming, even if something is changing in this area too, albeit with difficulty.

Thus, our extended concept of responsibility needs to be developed at different levels; to make it effective, it also needs embedding in the global mechanisms of science, in addition to the local and national levels. Only by ingraining responsibility in all these levels, responsibility can play its broader role, becoming useful for managing research, reducing wastage of time and resources, preventing any risk science and technology can generate in society, and reducing the unintended negative consequences of competition. This extended idea of responsibility aims at improving the lives of researchers, the functioning of research organisations, and their relations to society. Some elements of this extended concept of responsibility are the following (see Annex 1 for an overview).

Responsibility by design. Responsibility underlines that science is not routine work, especially in a fragmented and diversified society. The aims, use and consequences of research products are not self-evident and need to be selected and planned consciously. Whether this is done by individual researchers or by organizations or even governments, a specific view of science and science-society relations will inform such choices. So, some kind of 'responsibility-by-design' as part of the research process should be defined.

Responsibility by design

Responsibility by design – Experiences

- The University of Manchester Synthetic Biology Research Centre for Fine and Specialty Chemicals (Synbiochem) adopts an interdisciplinary approach and works in partnership with all four faculties of the University of Manchester. The institute includes an RRI platform for developing major programmes on the ethical and regulatory aspects of research, also including real-time assessment and anticipation of research and innovation trajectories, deliberation and reflection, and collaborative development. An internal RRI Group has been created, in charge of providing RRI expertise, guidance and training, thus defining an RRI process supporting all steps of the research and innovation process.
- In 2009, the Dutch Research Council (NWO) launched the Responsible Innovation Programme (MVI), characterised by responsible-oriented features and selection criteria, and especially the consideration of the ethical and societal aspects of the proposed innovation projects at an early stage. Applicants are requested to actively involve stakeholders in project implementation and the management of its results. An interdisciplinary approach, mixing humanities, natural sciences, and social sciences, is also included in the criteria to be adopted. A Responsible Innovation Platform with national scope has also been created.
- Applied Nanoparticles S.L. (AppNPs) is a spin-off of the Catalan Institute of Nanotechnology (ICN2), the University Autonoma of Barcelona (UAB) and the Institut Català de Recerca i Estudis Avançats (ICREA). AppNPs designed, developed, industrially scaled up, and commercially exploits BioGAS+, an additive based on iron oxide nanoparticles to optimise the production of biogas from organic waste. AppNps business is based on the principles of Responsible Innovation, focusing on the design processes of nanoparticles and low energy consumption, low toxicity, waste minimisation and reduction of emissions.

To know more, click below:

- ✓ **Synbiochem**
- ✓ **MVI**
- ✓ **AppNPs**

Responsibility offers a critical stance for observing science. Responsibility builds on the recognition that science has many internal problems to face, and many transformations to manage. By offering a critical stance, responsibility should help to prevent redundant papers, fake journals, distortions in research metrics, non-reproducibility of data, a hostile work environment for young researchers, women and minorities, etc. Such critical responsibility would strengthen inter- and trans-

Responsibility as a critical stance

disciplinary work with impacts on, for example, university structure, peer-review system, and the publication markets.

Responsibility as a critical stance – Experiences

- Midstream Modulation is an approach based on the inclusion of humanists and social researchers in laboratory work. Following a specific protocol, the laboratory staff is urged by social researchers and humanists to discuss ethically relevant topics, normative issues, social implications of their research and the ways in which decisions are taken. Midstream Modulation has been initially applied in a few research settings, starting from the Technical University of Delft, in the Netherlands. Now the approach is applied in other organisational and national contexts.
- SoScience is a small private enterprise based in Paris and established in 2013, providing advice and consultancy services to companies and organisations in the development of new research and innovation programmes, shaped around the concept of Responsible Innovation. Responsibility is proposed to the clients not as a limitation but as a cognitive framework to identify new market opportunities linking research and innovation projects to societal and environmental challenges, thus developing new marketable solutions.
- Athena SWAN Charter was established in 2005 in the UK to encourage and recognise the commitment to advancing the careers of women in STEM in higher education and research. Athena SWAN promotes a network connecting research institutions that applied for an Athena SWAN Award (bronze, silver and gold).
- EuroPriSe (European Privacy Seal) is a privacy certification system for IT products, IT-based services and websites that are compliant with the EU data protection system. The origin of EuroPriSe is to be found in two EC-funded projects, which led to the definition of a set of guidelines and criteria for data protection compliant and privacy-enhancing security technologies.

To know more, click below:

- ✓ **Midstream Modulation**
- ✓ **SoScience**
- ✓ **Athena SWAN Charter**
- ✓ **EuroPriSe**

Responsibility as a criterion to reshape science-society relations

Responsibility as a criterion to reshape science-society relations. Science is losing the special status of autonomy that it held in the old social contract. This shift needs to be managed and not simply endured. The blurring of boundaries between science and other societal systems should entail changes in research practices, research organisations and research systems. Responsibility could then be used to mitigate a potential decrease in trust in science, the risk to subordinate science to external influences, and the risk of over-accelerating the shift from discovery to innovation. Responsibility would also help scientists to better interpret and play their role as experts for policymaking and would provide practices and orientation for a smart inclusion of stakeholders in the research process. In this sense, responsibility could be viewed as one of the regulatory principles to help manage these processes, preventing risks and seizing opportunities.

Responsibility as a criterion to reshape science-society relations: experiences

- The Fraunhofer Center for Responsible Research and Innovation (CeRRI) is a German research unit based at the Fraunhofer Institute for Industrial Engineering (IAO), which provides services to other institutions and private companies related to Responsible Research and Innovation. CeRRI developed new approaches and methods that allow research agendas and technology development processes to be need-oriented from the very start, thus increasing the efficient use of research funds and the societal acceptance of future solutions. The staff includes members with knowledge and skills from different fields, such as the natural sciences, economics, design, communication, social sciences and computer science.
- The University Network Education by Responsibility (Hochschulnetzwerk Bildung durch Verantwortung) is an association of universities (37 at present) that aims to strengthen the civic engagement of students, teachers, and other university members. Formally established in Germany as an association in 2015, the University Network provides associate members with expertise, resources, learning and knowledge exchange opportunities, advocacy and lobbying, and joint research programmes. This is mainly done through "Service Learning", a teaching approach which combines lecture hall or classroom and civic involvement, engaging students and teachers in working with communities while learning and teaching.
- Research funding organisations sometimes require the adoption of responsibility-oriented action plans as a requirement to access public research funds. The European Commission, for example, asks research institutions applying for EC research funds to adopt an action plan aimed at attaining Gender Equality. Similarly, the US National Science Foundation requires that institutions that apply for financial assistance to certify they have a plan to provide appropriate training and oversight in the responsible and ethical conduct of research to students and researchers who will be supported by NSF. Similarly, the call for proposals by the Dutch National Research Agenda requires applicants to provide an impact plan based on a theory of change.

To know more, click below:

- ✓ **CeRRI**
- ✓ **University Network Education by Responsibility**
- ✓ **Adoption of Gender Equality Plans in European Research**
- ✓ **Ethical conduct in the framework of NSF-funded projects**
- ✓ **Adoption of the impact plan approach at the Dutch National Research Agenda**

Toward responsible biosciences

This Manifesto will now further develop the grammar and semantics of a new and extended concept of responsibility by returning to the domain of biosciences. The following agenda for the biosciences employs responsibility to explain how the biosciences can contribute to better managing current transformations in science and science-society relationships, and how they can contribute to a new social contract between science and society.

Observations

We highlight four observations from our previous analysis that will act as starting points for developing a practical agenda for action.

Trends towards responsibility are already there

Trends are already there. The first observation is that the introduction of responsibility as a guiding principle in the science-society relations does not need to begin from scratch but can build on existing trends. Various practices and experiences in science and society already recognise responsibility – explicitly or implicitly – as a component of the process and products of science.

Examples include citizen science, public engagement, advanced forms of science communication, science-based movements outside the universities, ethical debates on science, post-colonial science, equity and inclusion in science, open science, and interdisciplinary and transdisciplinary cooperation. The common feature in these examples is that science is considered a social institution that concerns and potentially benefits everyone – the idea of a widely-shared responsibility for the maintenance of the institutions of science.

Trends are contradictory and diversified

Contradictions and diversification. The second observation is that these trends do not necessarily all move in the same direction. Serious tensions thus exist within science and in various science-society relationships. Examples of such tensions are:

- The development of measures to ensure the well-being of researchers *versus* the increasingly 'acid' research environment, especially for young researchers
- The push toward increasing the involvement of stakeholders and non-scientific experts in science *versus* the push toward acceleration of the research process
- The push toward acceleration of the research process *versus* the increasing time scientists have to devote to non-research activities such as administration, grant preparation, communication and large-scale collaboration
- The increased attention to ethics *versus* the competition mechanisms that make researchers resort to unethical practices such as plagiarism, non-replicable experiments, redundant papers, and redundant research
- The demand for interdisciplinarity *versus* the demand for hyper-specialisation
- The increasingly claimed contrast between fundamental *versus* applied research
- The call to science for addressing societal challenges *versus* an increasing influence by business and politics on science
- The demand for a democratisation of science *versus* the growing pressure by non-democratic regimes on global science.

Diversification is also part of this same picture. Social attitudes toward science are diversified, ranging from strong support to all-out rejection.

Non-linear change. The third observation is that in such diversified and complex contexts, the introduction of responsibility as a critical principle for a new social contract between science and society can only be non-linear. The intended change will not happen as a simple project with a linear relationship from input to output. It will require interactions and negotiations between a broad range of relevant actors, some of whom not even realize they are relevant. Such interactions and negotiations inevitably result in different outcomes than what initially expected. Hence, change is complex and difficult to predict.

Introducing responsibility can only be a non-linear process

A clear view. The fourth observation is that, although change is non-linear, the goal and direction of change should be clear and explainable. We aspire to a science that is aware of the uncertainties in contemporary society, but also aware of the uncertainties in science itself. This double awareness should lead to offering and defending scientific insights where relevant, but not making unsupported promises and not 'over-selling' the possibilities of science. We aspire for science that proceeds with open eyes, takes nothing for granted, and is ready to change direction, if necessary to maintain internal quality. We aspire for science which is increasingly perceived and managed as a social endeavour, a multi-actor effort in which the scientific methods and scientific values are preserved under all circumstances. We aspire for science in which competitiveness is preserved but regulated to make it productive and to prevent it could become a distorting factor, ensuring mechanisms allowing all the actors to negotiate when needed. This is "open science".

The goal and direction of change should be clear and explainable

Reference points for change

To change the course of science towards a more balanced and responsible relationship to society, some reference points can be identified.

Where to change? Researchers are immersed in complex environments. The broader concept of responsibility as a guiding principle to better shape the relationship between science and society is meaningful in all of them, although contexts, though each has its own features.

Where to change

- *Local-organizational contexts*. The local context, often within research organisations, is the researchers' closest context even though it is strongly mixed with inputs from others.
- *Disciplinary-professional contexts*. Responsibility will need to assume different shapes in different disciplinary contexts. These disciplines are typically maintained in professional associations, and disciplinary values are mirrored in professional norms and codes. In this Manifesto, we are especially focusing on the bioscience disciplines and professions. Interdisciplinary and transdisciplinary work is advocated, even though specialisation is still profitable for one's career development.

– *Cultural and socio-political contexts*. Although science is universal, local interactions with industry, political decision-makers, local authorities, users, and stakeholders do matter.
– *Global contexts*. Many aspects of scientific practice play out at a global level: publishing, research collaboration, resource availability, and training capacities.

Each of these contexts will require specific forms of institutional change in order to result in a new stable social contract between science and society. These various institutional changes would, ideally, show synergy and reinforce each other. To help this happen, we need to think of the organisations, relevant to these various contexts, to be connected in large networks.

What to change

What to change? Introducing responsibility in these different contexts, as argued above, implies negotiating. But negotiations on what? Four different "layers" where the negotiation process occurs can be identified.

– *Interpretations*. What meanings are attributed to science, scientists, scientific work, the public, and various stakeholders? Who is responsible for what?
– *Symbols*. Symbols play a key role in communication and interaction about science, scientists, scientific practices, and science organisations – they may come in the form of images, keywords, examples, narratives, etc.
– *Norms*. Scientific work, like all social activities, is guided by norms. In addition to the general CUDOS norms, specific social, legal, ethical, and regulatory norms apply.
– *Practices*. The daily work of scientists happens in a variety of practices – organisational, laboratory, teaching, publishing, peer-reviewing, grant writing, assessment and evaluation, etc.

How to change

How to change? In most cases, change does not occur through simple causal chains, but through complex configurations of cause and effect. The same causal factor may work or not work, depending on the context it is part of. The same effect can be produced through different configurations of factors (equifinality) and the same configurations of factors can lead to different outcomes (multifinality). So, change should be a learning process, aimed at identifying the factors producing the present state of affairs and at identifying the factors that can be modified to introduce responsibility in science. No specific pathway (e.g., top-down or bottom-up) can be adopted *a priori*. The previously argued attention to networks of change underlines this point: there will be various pathways of change through any network.

Navigating a new social contract between science and society

In this Manifesto, responsibility is elaborated as a concept to guide institutional practices for better managing current transformations in science and science-society relationships. A new social contract between science and society is needed. Responsibility, as presented in this Manifesto, allows for better balancing between sustainability and profitability, between goal-focused research and curiosity-driven research, and between open science and market-driven science. This is a complex endeavour that cannot be captured by a simple agenda for action. Rather, the Manifesto proposes to embark on a journey – starting from the four observations and guided by the three reference points. Navigating this complex journey toward a new social contract includes *five instruments*: goal setting, analysis, realisation, stabilisation, and learning.

These instruments can all be applied to the four contexts that were identified previously: the local-organizational context, the disciplinary-professional context, the social-cultural context, and the global context.

Goal setting

What aspects of the science-society relationship will be primarily targeted as intended change? The observations discussed above can help to specify this choice.

- ✓ What are the current trends with which the intended change can be aligned to and thus supported by?
- ✓ Which specific tensions in the science-society relationship will the intended change probably interfere with?
- ✓ What brief and clear, albeit simplified, goal can be used as an identifier for the intended change process?
- ✓ To what extent inclusion of concerned social groups and cooperation among them could be fed to improve the research quality?

Analysis

With the second instrument, *analysis*, the relevant contexts, actors and organisations are mapped, and their specific responsibilities are identified and described. The *reference points* discussed above can help to specify the choices.

- ✓ Where is the change expected to play out: in the local-organizational context, the disciplinary-professional context, the social-cultural context, and/or the global context?
- ✓ What actions are needed?
- ✓ On what will these actions intervene: on interpretations, symbols, norms, and/or practices?
- ✓ Who (which actors and/or organizations) could take responsibility for these actions?
- ✓ To whom (to which fora, actors or organizations) will these responsibility-bearing actors be held accountable?

- ✓ How to anticipate the risks and unintended consequences of the change process?
- ✓ Identify other related agencies for change (in addition to the responsibility-bearing actors).
- ✓ Define a possible pathway of change formed by the identified actions.
- ✓ List obstacles and resistance against, as well as supportive trends and experiences in favour of, realizing that pathway of change.

Realisation

Once the analysis has produced a map of actions and responsibilities, the practical *realisation* follows. This will, in addition to carrying out the identified actions, typically require various negotiations to find support amongst relevant stakeholder groups.

- ✓ Mobilise supporting actors and organisations, who can share the responsibility.
- ✓ Engage in negotiations at the appropriate level (the local-organizational context, the disciplinary-professional context, the social-cultural context, and/or the global context).
- ✓ Carry out the identified actions.
- ✓ Deal with resistance and obstacles.
- ✓ Reflectively and self-critically monitor the responsibilities.
- ✓ Engage in an early stage with the relevant fora, actors, or organizations with which change actors can play a liaison role within the institution.

Stabilisation

Once the planned path of change has been followed, the resulting changes need to be *stabilised*.

- ✓ Consolidate the resulting changes in interpretations, symbols, norms, and practices in institutional and regulatory arrangements, procedures, and routines.
- ✓ Make a self-assessment report on how the responsibilities have been taken.
- ✓ Engage in the final accountability process with the agreed fora, actors and organizations.

Learning

Change processes in the relationship between science and society are inevitably so complex that one pathway of change will never suffice – an ongoing cycle of change-reflection-learning-change will typically be required.

- ✓ Understand the process as accomplished.
- ✓ Evaluate the resulting change.
- ✓ Formulate weaknesses and points of next attention.
- ✓ Draw up a responsibilities plan: How have the previously identified responsibilities been taken? How have they been evaluated by the organisations?
- ✓ Define a new pathway of change.
- ✓ Start a new cycle.

In Annex 2, we attach one partial example of applying this process, drawn from the experience of one of the ResBios partners: the Ivan Franko National University – Lviv (Ukraine).

Background readings

On the development of mode 1 to mode 2 science: Nowotny, Helga, Peter Scott, and Michael Gibbons. 2001. *Re-thinking science: knowledge and the public in an age of uncertainty*. Cambridge: Polity Press in assoc. with Blackwell.

On exploring some of the struggles of present-day universities: Sørensen Knut H. and Sharon Traweek. 2022. *Questing Excellence in Academia. A Tale from Two Universities*. London: Routledge.

On post-normal science: Funtowicz, S.O., and J. R. Ravetz. 1993. "Science for the post-normal age." *Futures* 25 (7):739-755.

On the socialisation of scientific and technological research: Bijker, Wiebe E., and Luciano d'Andrea, eds. 2009. *Handbook on the Socialisation of Scientific and Technological Research. A tool for promoting science and technology socialisation policies addressed to policy makers, research and innovation actors and stakeholders*. Brussels: EU.

On a new social contract for science: Bijker, Wiebe E. 2020. "Call for a new social contract between science and society." *Seminar* (733):16-21.

On RRI's four dimensions: Stilgoe, Jack , Richard Owen, and Phil Macnaghten. 2013. "Developing a framework for responsible innovation." *Research Policy* 42:1568-1580.

On RRI application in 10 European projects: Schomberg, René (editor), 2011. *Towards responsible research and innovation in the information and communication technologies and security technologies fields*, Publications Office, European Commission, Directorate-General for Research and Innovation https://data.europa.eu/doi/10.2777/58723

On CUDOS values of science: Merton, Robert K. 1942 (1973). "The normative structure of science." In *The sociology of science: Theoretical and empirical investigations*, edited by Robert K. Merton, 267-278. Chicago: University of Chicago Press.

On institutional change: Kalpazidou Schmidt, Evanthia and Cacace, Marina. 2019. "Setting up a dynamic framework to activate gender equality structural transformation in research organizations". *Science and Public Policy*, 46(3), 321-338; Kalpazidou Schmidt, Evanthia (forthcoming). *RRI implementation in research organisations: Creating a contextualised developmental framework for evaluating structural change in biosciences.*

On knowledge, responsibility and scientific citizenship: Quaranta, Giancarlo. 2007. "Knowledge, responsibility and culture: food for thought on science communication", *Journal of Science Communication*, 6 (4) https://jcom.sissa.it/sites/default/files/documents/Jcom0604%282007%29C05.pdf

On how the values of science can also be constitutive of democracy: Collins, Harry, and Robert Evans. 2017. *Why Democracies Need Science*. Cambridge: Polity Press.

Contributions from our projects on responsible biosciences

Publications from the ResBios project (2020-2022): https://resbios.eu/resources#publications

Publications from the STARBIOS2 project (2016-2020) (Guidelines on RRI implementation in bioscience organizations; Strategic Document and others): https://starbios2.eu/publications/

Annex 1: A new conception of responsibility – some examples

Local-organizational contexts: aimed at changing single research organisations
Disciplinary-professional contexts: aimed at changing disciplinary and professional cultures and practices
Social-cultural contexts: aimed at changing attitudes, cultural orientations, skills, and capacities in the wider society
Global contexts: aimed at stimulating the development of new research styles and models

	Local-organizational contexts	**Disciplinary-professional contexts**	**Social-cultural contexts**	**Global contexts**
Responsibility by design	• Early attention to the ethical and regulatory aspects of research, also including real-time assessment and anticipation of research and innovation trajectories, deliberation and reflection, and collaborative development • Consideration of the ethical and societal aspects of the proposed innovation projects at an early stage • Interdisciplinary mixing of humanities, natural sciences and social sciences • Adoption of participatory research and Citizen Science approaches in research • Creation of RPOs in which responsibility is fully integrated into the R&I process (see, e.g., Synbiochem[2])	• Guidance and training on ethics and integrity • Integration of Risk Analysis and technology assessment in R&I (see, e.g., NanoNextNL[3]) • Integration of beneficiaries' needs in developing a research programme (e.g., the Quality research in Dementia network and programme of the UK Alzheimer Society[4]) • International scientific societies and networks establishing criteria for exercising responsibility in the disciplinary research • Participatory mechanisms in disciplinary research (e.g., the Wilson Centre "Citizen Health Innovators Project"[5]) • Consultancy services provided to support R&I actors in adopting responsibility-oriented procedures (e.g., the private firm SoScience in France[6])	• Associations and networks promoting responsibility-oriented research among universities and research institutions (e.g., EUREC, the European Network of Research Ethics Committee[7] or GEWISS in Germany[8]) • Courses, training centres, and resource centres on responsibility-oriented research design and implementation (e.g., UK National Co-ordinating Centre for Public Engagement[9]) • Scholarship on responsibility-oriented issues	• Responsibility-oriented requirements in research and innovation funding schemes (e.g., the Norwegian Biotek2021 funding scheme[10]) • International certification systems of new research-based technological products including responsibility-related criteria (e.g., EuroPrise for the protection of privacy in the IT sector[11]) • Establishment of a Responsibility framework at national and international level (e.g., UKRI RRI Framework[12] and EU RRI program[13])

[2] See: https://synbiochem.co.uk/about/
[3] See: https://www.wur.nl/en/project/nanonextnl-detecting-the-risks-of-nanotechnology.htm
[4] See: https://www.alzheimers.org.uk/research
[5] See: https://www.wilsoncenter.org/about-the-citizen-health-innovators-project
[6] See: https://www.soscience.org/en/home-2/
[7] See: http://www.eurecnet.org/index.html
[8] See: https://www.buergerschaffenwissen.de/en
[9] See: https://www.publicengagement.ac.uk/
[10] See: https://www.forskningsradet.no/siteassets/publikasjoner/1253985013190.pdf
[11] See: https://www.euprivacyseal.com/EPS-en/Home
[12] See: https://www.ukri.org/about-us/epsrc/our-policies-and-standards/framework-for-responsible-innovation/
[13] See: https://op.europa.eu/en/publication-detail/-/publication/ee9bacdf-fdad-46eb-8cd8-32879e310191/language-en

	Local-organizational contexts	Disciplinary-professional contexts	Social-cultural contexts	Global contexts
Responsibility as a critical stance to observe science	• Midstream Modulation[14]: including humanity scholars and social-science researchers in laboratory work to discuss ethically relevant topics, normative issues and social implications of the lab research • Ethics committees at the research organisation level • Integration of research at a community level (e.g., science shops, engaged university research programmes, etc) • Stakeholder consultations before launching new research projects or products (e.g., BASF before launching GMO potatoes or the French National Institute for Agricultural Research on GMO grapes) • Establishment of tools to involve citizens in critically reflecting on ethical aspects of research projects (e.g., the Moral Machine Platform[15])	• Prevent redundant papers, fake journals, distortions in research metrics, and non-reproducibility of data (e.g., the Cochrane-REWARD Prize to reduce research waste[16]) • Prevent a hostile work environment for young researchers and women • Guidelines and criteria for data-protection compliant and privacy-enhancing security technologies • National committees oversee the ethical and governance-related issues (e.g., the UK Biobank Ethics and Governance Council-EGC[17]) • Creation of responsibility-related committees in scientific societies in biosciences (e.g., the parity commission at the European Society of Clinical Microbiology and Infectious Diseases – ESCMID[18])	• New market opportunities are identified by linking research and innovation projects to societal and environmental challenges • Open access platforms allowing unrestricted access to scientific data (e.g., Berkeley Earth on data on climate sciences allowing access to raw data and their analysis code online[19])	• Responsibility as one of the criteria adopted in peer-review (when appropriate) • University networks for engaged universities (like, e.g., the Forum of Engaged Universities in Poland) • Creation of new models of university sensitive towards responsibility-related issues (e.g., the Arizona State University, "The Good University" reform)
Responsibility as a criterion to reshape science-society relations	• Provide expertise, resources, learning, knowledge exchange, advocacy and lobbying. • 'Service Learning': a teaching approach that combines classroom teaching with civic involvement, engaging students and teachers in working with communities • Training and oversight in the responsible and ethical conduct of research to students and researchers	• Blurring of boundaries between science and other societal systems should entail a critical analysis of the strengths and weaknesses of each subsystem • Training and guidance for scientists as experts for policy • Civic engagement of students, teachers, and other university members • Action plans aimed at improving gender equality	• Address a potential decrease in trust in science • Mitigate the risk to subordinate science to external influences • Mitigate the risk of over-accelerating the shift from discovery to innovation • Smart inclusion of stakeholders in the research process • Research agendas and technology development processes are needs-oriented from the very start • Provide an impact plan on the basis of a theory of change	• Creation of multi-stakeholder committees in defining research funding schemes e.g., the VINNOVA Challenge Driven Innovation – CD[20]I) • Creation of social partnership to prioritise R&I research policies (e.g., Blue INNOShip in DK[21]) • Use of participatory scenario-building techniques to prioritise R&I sectoral programme (e.g., Agenda EAU Project in France[22])

[14] See: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3242941/
[15] See: https://www.moralmachine.net/
[16] See: https://www.cochrane.org/news/cochrane-reward-prize-winners-announced#:~:text=The%20Cochrane%2DREWARD%20prize%20recognizes,to%20COVID%2D19%20were%20encouraged
[17] See: https://www.ukbiobank.ac.uk/learn-more-about-uk-biobank/about-us/ethics
[18] See: https://www.escmid.org/profession_career/parity_commission/
[19] See: http://berkeleyearth.org/data/
[20] See: https://www.vinnova.se/en/m/challenge-driven-innovation/
[21] See: http://www.blaainno.dk/
[22] See: https://rri-tools.eu/-/agenda_insp_practice

Annex 2: Example of navigating a new social contract

This example is drawn from the Ukraine ResBios case, see ResBios Deliverable D6.1 ("Collection of Success Stories and Sustainability and Support Plans revised")

Goal setting – What are the current trends with which the intended change can be aligned and thus supported by? – Which specific tensions in the science-society relationship will the intended change probably interfere with? – What brief and clear, albeit simplified, goal can be used as an identifier for the intended change process?	– Trend to involve knowledge users in an early stage of research – Lack of interest in science among citizens – Goal is to stimulate amongst citizens a better understanding of and involvement in scientific research
Analysis – Where is the change expected to play out: in the local-organizational context, the disciplinary-professional context, the social-cultural context, or the global context? – What actions are needed? – On what will these actions intervene: on interpretations, symbols, norms, and/or practices? – Who (which actors and/or organizations) could take responsibility for these actions? – To whom (to which fora, actors or organizations) will these responsibility-bearing actors be held accountable? – Identify other related agencies for change (in addition to the responsibility-bearing actors) – Define a possible pathway of change formed by the identified actions – List obstacles and resistance against, as well as supportive trends and experiences in favour of, realizing that pathway of change	– The intended change will play out mostly in the social-cultural context (i.e. changing attitudes and values of citizens about science), but also in the disciplinary-professional context (i.e. changing practices of bio-science research and professional norms of bio-scientists) – Actions in communication and teaching. – Actions will intervene on interpretations (of what science is and can do), on norms (about openness of science) and on practices (of engaging non-scientists in research) – Bio-scientists (in particular of Ivan Franko National University of Lviv), schoolteachers, citizens – The Lviv scientists are accountable to their partners in the EU project ResBios; schoolteachers and citizens are only accountable to themselves until concrete arrangements have been created in which they engage in specific actions. – National Academy of Sciences of Ukreaine; Ministry of Education and Science; and a broad range of NGOs: My Science portal; Days of Science campaign; LigaLife; Real Science channel; Interesting Science channel; Science picnics; INSCIENCE – Actions will create a more adequate understanding of scientific research amongst citizens in general and young people (aged 10-20) in particular; this will lead to more engagement with science, both positive and supporting and critical; more students will choose an education in science Obstacles: Ukraine society's disruptions because of the Covid-19 pandemic and the invasive war by Russia Supporting trends in public interest in (re)building Ukraine society; engaging with an EU project to strengthen scientific research and science-society relations
Realization – Mobilise supporting actors and organisations, who can share in taking responsibility	– Collaboration with organisations mentioned above.

– Engage in negotiations at the appropriate level (the local-organizational context, the disciplinary-professional context, the social-cultural context, or the global context) – Carry out the identified actions – Deal with resistance and obstacles – Reflectively and self-critically monitor the responsibilities – Engage in an early stage with the fora, actors or organizations to which the primary change actors will be held accountable	– Done – Created Summer School on nutrition as an annual initiative; created YouTube channel with videos on molecular biology – Intermediate and final reporting to peers in EU project ResBios
Stabilisation – Consolidate the resulting changes in interpretations, symbols, norms, and practices in institutional and regulatory arrangements, procedures and routines – Make a self-assessment report on how the responsibilities have been taken – Engage in the final accountability process with the agreed fora, actors and organizations	*(these steps are still in the future)*
Learning – Understand the process as accomplished – Evaluate the resulting change – Formulate weaknesses and points of next attention – Draw up a responsibilities plan: How have the previously identified responsibilities been taken? How have they been evaluated by the accountability organisations? – Define a new pathway of change – Start a new cycle	