This is a draft chapter. The final version is available in: *International Handbook on Responsible Innovation: A Global Resource* (pp. 167-180), edited by René von Schomberg and Jonathan Hankins, published in 2019, Edward Elgar Publishing Ltd. https://doi.org/10.4337/9781784718862.00018

# Dynamics of responsible innovation constitution in EU research policy: tensions, possibilities and constraints

*Hannot Rodríguez*, University of the Basque Country UPV/EHU

*Andoni Eizagirre*, Mondragon University

*Andoni Ibarra*, University of the Basque Country UPV/EHU

**Abstract:** Over the last three decades, research policy in the European Union (EU) has increasingly taken on board criteria of responsibility, while actively promoting R&D activities. However, these initiatives need to be analyzed in light of the way they coalesce with the prescriptive impulse of innovation, primarily conceived as a socio-economically strategic construct. The evolution and scope of responsible innovation policies may be interpreted as attempts to manage the relationships, or trade-offs, between dynamics that are more committed to economic competitiveness and those that appeal for greater openness in innovation processes. This enables us to conceive science and its relations with society in terms of contingency, as posited in its most radical version by the 'Responsible Research and Innovation' (RRI) approach. However, the fact that there are certain relations more resistant to change is also clear, which is expressed and justified according to an interpretation that seeks to fix boundaries for the relations between science and society. This basic tension, and the open-and-shut dynamics associated with it, need to be addressed through an analysis of the principles, assumptions, objectives

and resistances that shape the content, evolution and scope of responsible science and technology policies in Europe.

## 1. Introduction

Over the las three decades, research policy in the European Union (EU) has increasingly encouraged the inclusion of social responsibility criteria in conjunction with the promotion of scientific R&D activities. The inclusion of responsibility issues in science policy planning has become gradually more radical over time, in relation to variables such as the areas of knowledge affected, the set of problems considered relevant, the type of players involved, and the degree of influence of the dynamics of planning on the actual processes of the constitution of knowledge and innovation (Owen et al. 2013).

Any inquiry into the progressive radicalization of responsible innovation policy needs to take into account how this type of proposal is formulated and how it has evolved over time in conjunction with the prescriptive impulse of innovation, primarily conceived as a socio-economically strategic construct. We do in fact argue that it is possible—necessary even—to interpret the evolution and scope of responsible innovation policies as attempts to manage the relations, or trade-offs, between dynamics more committed to economic competitiveness—a benchmark referent of any science policy—and those seeking greater openness or indeterminacy in innovation processes. For one thing, this allows us to conceive science and its relation to society in contingent, or non-"dogmatic" terms. It also forces us to become aware that there are certain relations that are more resistant to change. The present article seeks to account for these open-and-shut dynamics by examining the principles, assumptions, objectives

and entrenchments by which the content, evolution and scope of responsible science and technology policies are constituted in Europe.

To begin with, we give a brief overview of the history of responsible science and technology innovation policies in Europe from the mid-1980s to the present day (section 2). Then we look at the scope and limitations of such policies in Europe in light of the socio-institutional dynamics by which the uneasy relationship between commitment to innovation as a socio-economically strategic factor and the demand for the social modulation of progress materializes and is managed (section 3). This we ground on the recognition of the eminently economics-based nature of innovation (section 3.1), and in light of the elucidation of the conceptual, boundary-setting substructure underlying institutional initiatives to reconcile science and society (section 3.2). Section 4 looks at and relativizes the current 'Responsible Research and Innovation' (RRI) proposal, which argues for opening up to debate the underlying motives and objectives of innovation processes, beyond previous proposals for socio-technical integration where, despite everything, the functional gap between science and society remains. Our conclusions (section 5) recapitulate the article's main arguments and results, and include a suggestion for a possibilist interpretation of the scope and potential of RRI, without neglecting the underlying tension so characteristic of institutional attempts to manage the relations between promotion and modulation.

## 2. Responsible science and technology in Europe: growing radicalization

Developments in science and technology, typical features of the modernization and industrialization processes in our societies over the last four centuries, have endowed humanity with a notable capacity to discover and transform the world (Ridley 2010). Linked to this ability to transform and manipulate reality, and in a context of hyper-competitive, globalized economic capitalism, largely based on the production and ceaseless consumption of value added goods, scientific and technological progress has become, in the early years of the 21st century, an essential factor of innovation; in other words, an industrial cornerstone of progress and economic competitiveness (Marklund et al. 2009). Like other institutions of government in industrialized countries, the European Commission (EC) thinks that '[b]y improving conditions and access to finance for research and innovation in Europe, we can ensure that innovative ideas can be turned into products and services that create growth and jobs' (EC 2013a, p. 8).

However, the instrumental relevance of science and technology developments is not just posed solely in economics-based terms. Such developments are also seen as key for the solution of social and environmental challenges and problems. In the late 1990s, in the context of the Fifth European Framework Programme for Research and Development (1998-2002), the then European Commissioner for Research (1999-2004) Philippe Busquin, as a key factor in the constitution of the European Research Area, ERA, called for the integration of the socioeconomic dimension 'into the specific programmes of the Fifth Programme to take full account of the needs of European Society and of the economic and social challenges it faces' (Busquin 2003); in that dimension he included criteria and initiatives for improving human health and the protection of the environment in contexts without evident market value (EC 2003).

The resolutive nature of problems associated with science and technology innovation has gradually been exacerbated, to the point where the eighth Framework Programme for Research and Development, or 'Horizon 2020', defines and formulates R&D practices it finances according to a challenge-based approach, given that '[s]mart investment, notably in research and innovation, is vital in order to maintain high standards of living while dealing with pressing societal challenges such as climate change, an ageing population, or the move towards a more resource-efficient society' (EC 2011, p. 2). This approach, in turn, means subverting the disciplinary frontiers of research, as the emphasis is placed on the actual problems, rather than on areas of knowledge, whose complexity inevitably forces cooperation, or integration, of a heterogeneity of research fields (EC 2011, p. 5).

Science and technology are thus conceived, on the basis of what we have underscored until now, as problem-solving, which means the measure of the responsibility of these activities is determined in accordance with its readiness and effectiveness for improving realities "unconnected" to them. But the question of scientific and technological responsibility should also be considered in the light of problems associated with their own progress and dynamics. That this is so can be gleaned from the ambiguous attitude our societies have to scientific and technological progress: they promote such progress, trusting in their ability to guarantee and improve levels of social wellbeing, but at the same time they regulate it and treat it with suspicion and concern, in accordance with a variety of impacts, or dimensions, pretty much in line with what we propose in the following schema:

On one hand, (i) science and technology developments are a motive for health and environmental concern, with the way they are used to cause damage—as occurs, for

instance, in the case of technological innovations for war (Black 2013), and with the non-intended impacts like progressive environmental contamination (Shrader-Frechette 2007) or technological accidents (Perrow 1984). Further, (ii) scientific and technological advances also raise serious socio-ethical doubts as to intended and apparently beneficial impacts. The use of genetic engineering to "improve" the human being could entail permanent dissatisfaction, based on the capacity to redefine "normality" and treat as problems abilities and characteristics until then assumed as constitutive of the human being (Sandel 2007; Fukuyama 2002).[1] Finally, (iii) scientific advances also bring broader impacts of a cultural sort. Science, as it offers more precise representations of reality, subverts the way we appreciate and endow our lives with meaning. Darwin's theory of natural selection, for instance, transcends the strictly scientific; it implies a radical change in our understanding of ourselves, as it presents humans as one evolved species out of many such species (and in relation to others), deprived of a God stripped of any metaphysical or explanatory role (Dennett 1995; Weinert 2009, chapter II).

In this sense, the emergence of social concern about, and suspicion of progress made in science and technology should be understood in the light of their own success, i.e. as a direct result of the progressive technoscientification of our lives and surroundings. In the 1960s, the triumphal march of techno-industrialism faced growing social demand for industrial developments to be in greater harmony with the environment, which led in Europe and other industrialized areas to the systematic introduction of obligatory regulations and rules designed to prevent the ecological impact of technological progress (Klemmensen et al. 2007, pp. 39-42).

[1] Linked to this is the more general question of the end purpose of science and technology innovations, often designed to satisfy a superficial consumerism instead of basic human needs (Cozzens and Wetmore 2010; Sarewitz 1996, pp. 117-140).

However, the desire to integrate the advances, procedures and objectives of science and technology with social pluralism is defined by having gone beyond the mere reactive satisfaction of a series of limiting regulations (i.e. compliance). In other words, such integration has likewise been viewed in proactive terms, so that research and development processes can actually benefit in their constitution from socio-ethical reflection. By way of example, the EU has been promoting research into ethical, legal and social issues (ELSA, Ethical, Legal and Social Aspects) associated with advances in Life Sciences since the early 1990s, when it made a research programme into 'preventive medicine', based on the Human Genome Programme, and financed as part of the Second Framework Programme on Research and Development (PM2, 1987-1991), dependent on an ethics committee set up for the purpose (Elizalde 1998, p. 12).

The terms in which the socio-technical conjunction is formulated and implemented have been growing gradually more radical with the passing of time, in relation to a series of variables such as the knowledge areas affected, the set of problems considered relevant, the type of players involved, and the degree of influence the dynamics of the interlocking of social and technological issues exert on the actual processes of knowledge and innovation constitution. This is clear from an analysis of the evolution of EU Framework Programmes, which are the principal financing instrument for research and innovation in the region. FP3 (1991-1994) widened the scope for applying social and ethical consideration to the area of research into biomedicine, setting up for that purpose a specific sub-area on Medical Ethics, and FP4 (1994-1998), in turn broadened the scope for applying ELSA to all other areas of Life Sciences, including research programmes on biotechnology and the food and fishing area (Elizalde 1998, p. 12).

From FP6 (2002-2006), the EU argued for extending the scope for applying ELSA research to all areas of knowledge, beyond Life Sciences. As the Council of the European Union Decision on FP6 and its principles declared, 'consideration of the ethical, social, legal and wider cultural aspects of the research to be undertaken and its potential applications (…) will where relevant form a part of the activities[2] under this heading' (Council of the European Union 2002, p. 7). This declaration marks a change in the way in which the influence of social and ethical research on R&D processes is conceived: rather than an exercise in external reflection on the relatively autonomous activity of scientists and engineers, what we seem to have is something that should be an integral part of the dynamics of scientific and technological R&D. This idea is expressed even more clearly in the context of FP7 (2007-2013), in connection with which the European Commission hinted at 'a research process aiming as much at the harmonious societal integration of new scientific and technological knowledge as to achieving the specific objective of the research itself' (EC 2007, p. 6).

This increase in the intensity of calls for social and technical integration over the last ten years is also to be found in the insistence on the need to bring extra-academic players into the dynamics of innovation. The then EC Deputy Director General for Scientific Advances, Zoran Stančič, declared, in reference to the FP6-FP7 transition, that '[m]ore must be done … to find ways of actively engaging with civil society, stakeholder groups and the public at large in the preparation and execution of research' (Stančič 2007, p. 1).

[2] It refers to research activities in the knowledge areas of FP6, which means it does not refer exclusively to Life Sciences.

The progressive radicalization of demands for the engagement of science with society was made even more explicit in relation to FP8 (2014-2020), where, according to the EC, R&D activities have an RRI focus, by which 'all societal actors (researchers, citizens, policy makers, business, third sector organisations etc.) … work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of European society' (EC 2013b, p. 4). In other words, in this model responsibility extends to the desired results of innovation, and not just to the social modulation of technological innovations whose motivations are usually debate-proof. The degree of science and technology's social responsibility would then be based on the will and ability to engage the processes and results of innovation with the epistemological and regulatory diversity of our societies. In accordance with this invitation to extra-academic players to take part in the actual processes of scientific and technological research, responsible innovation is seen as an open question, a kind of problem whose definition and satisfaction depends on the contingency of the actual dynamics of interaction between players.

However, this radicalization process must be understood and appreciated in light of socio-institutional dynamics and tensions typical of attempts to accommodate the economics-based priorities and criteria of scientific policy and the demands for socially more responsible science and technology.

## 3. Responsibility and its limits

As we have already noted, the continual radicalization of responsible scientific policies in Europe needs to be analyzed in light of the tensions, or difficult relations, between the commitment to innovation as a socio-economically strategic factor and demands for the social accommodation of scientific and technological progress. This section discusses these issues. We first provide a brief historical and conceptual overview of the economics-based foundations of science policy (section 3.1), followed by a more detailed description of the way in which European institutions managed the complicated task of accommodating social responsibility issues in their R&D policies, based on a conceptualization that set boundaries between science and society (section 3.2).

### *3.1. Innovation as core of economic policy*

From its origins, research policy has been imbued with the triumphalist vision of scientific progress. The vision sees social and economic wellbeing as depending essentially on laying out major financing on the search for scientific knowledge while guaranteeing the functional and moral independence of scientists from the technological applications of knowledge (Bush 1945).

Although from the 1960s on proposals emerged for the first time on the need to adapt the scientific supply to market demand, such changes still failed to question the scientist's autonomy from the technological consequences (OECD 1968; 1971; 1972a). This also found justification in academic circles, in Merton's 1942 thesis on the scientific *ethos*, Polanyi's republic of science (1961), and forecasts of a knowledge society based on the epistemology and logic of research (Lane 1966) and the end of ideologies and consolidation of technocratic societies (Bell 1962).

But that did not imply this perspective would be completely resistance-free. In response to strong social criticism of science and the techno-industrial development drive, linked to countercultural movements in the late 1960s, proposals surfaced calling for a new relationship between science and society. For instance, in institutional circles, the Brooks Report concluded that a 'new science policy' was needed (OECD 1972b, p. 12) to integrate social and environmental issues as more than just desirable objectives. The Stockholm Declaration of the United Nations Conference on the Human Environment proclaimed the need to defend and improve the environment while other fundamental, solidly established goals (peace, economic and social development) were also pursued (UN 1972). Similarly, although from a theoretical economic perspective, E. F. Schumacher (1973) argued for an 'appropriate technology', which he identified as being designed to criteria of the right scale and applicability for receptor societies and the ecosystems those societies lived in. Linked to all this, and more closely connected with the academic world, is the emergence of research programmes on science, technology and society, involving critical analysis of policies regulating the social and environmental impacts of technologies (e.g., Shrader-Frechette 1980) and the demand for science and technology processes to be democratized (e.g. Nelkin 1977; Winner 1977).

Even so, from the 1980s, another series of dynamics that placed the responsibility of science in the "external" object of economic benefits became increasingly relevant. In 1980, the OECD's *Technical Change and Economic Policy* report (1980) raised the alarm about the pressing need to implement initiatives to harmonize economic and technology policies. However that may be, the OECD reports on 'Technology and economic policy' explicitly situated theories of technological change at the heart of

economic policy (OECD 1991a; 1991b; 1992).[3] This approach held sway in its essentials throughout the 1990s and the early 21st century, with only minimal variations, such as the progressive insistence on centering scientific policy in more localized or regional contexts. Here social and institutional dynamics required a horizontal innovation policy implicating a range of players and government areas, as an economic imperative, and a discursive, conceptual and political repertoire anchored in the objective of tackling the competitive global economy (OECD 1999; 2005).

Beneath all these proposals, inspired by the neo-Schumpeterian tradition of innovation studies (cf. Godin 2015, pp. 261-280), and even produced in line with the principal ideological guidelines of neoliberal capitalism and unlimited growth (cf. Pellizzoni and Ylönen 2012), lurks the idea that technological innovation is the main driver of productivity and economic growth (OECD 1996).

This does not mean that science and technology policies at that time did not concern themselves with analyzing and managing the problems associated with progress, i.e. that they didn't echo the growing social demand for more regulated and socially-oriented development of technologies (Bauer 1995; Hajer 1995). However, they were still undercut by a fundamental assumption about the basic compatibility of technologically-guided economic growth and the protection of nature and human values and principles. If we focus more specifically on concern for the environment, we see that the concept of 'sustainable development' covers two complementary principles,

[3] Here we refer to OECD reports because, as Godin (2009) illustrates, institutional rhetoric on science and its development in different national and regional systems was subordinated to political language fabricated by the OECD through science and technology statistical data selection and collection and the measurement indicators used. R&D policies in Europe match OECD guidelines at all times.

namely that environmental investment strengthens growth and that growth is a requisite for the protection of the environment (EC 1992; OECD 1989).

### *3.2. Science-society demarcation policies*

The arrival of the new century was accompanied by an institutional review of the way in which the social implications of science were considered and managed, in the context of a sharp social debate over food and agricultural biotechnology and the failure to regulate mad-cow disease in the 1990s, as well as a series of other food crises (Wales and Mythen 2002).

Relative failures in regulatory policy go a long way to explaining the emergence of dynamics and attitudes of social distrust of technology and its managers. This loss of legitimacy, diagnosed by the EC in more general terms—i.e. in relation to effective management of the European institutional system as a whole—in its *White Paper on European Governance* (EC 2001), was analyzed more specifically for science-society relations in the *Science and Society: Action Plan* report (EC 2002). The report puts forward a series of specific strategies and actions to promote dialogue between scientists and society and strengthen ethical controls on research dynamics.

However, these movements, or transformations, are still strongly conditioned by the economic commitments underlying European science policy, and more specifically the EU's strategic objective 'to become the most competitive and dynamic knowledge-based economy in the world' by 2010 (Council of the European Union 2000). In other words, these conditions are immediately qualified by the question of to what extent can we design and implement responsible innovation policies that might call into question,

or hinder, the strategic objective that informs the 'European Research Area' initiative, linked to the principle of an innovation-based economy, and the coordination of European research serving this principle (EC 2000).

One expression of this tension, which would limit the content and scope of responsible innovation policies, is the way European institutions describe science and its relations with society in the Eurobarometers of the time. Eurobarometer 225 *Social Values, Science and Technology* (EC 2005) looks at social reluctance to accept certain technological innovations in terms of conflicts between the freedom to research and moral values, i.e. in terms of a base-line boundary between the scientific and social aspects of innovation, which implicitly sees science as an autonomous activity only open to public debate through the exclusive consideration of its "external" impacts.

This boundary-setting strategy, indicative of the tensions underlying European science policy at the time, prevented any attempts to resolve the question of responsibility at the core of scientific activity. Significantly, one of the working documents the EC commissioned at the beginning of the century, when the groundwork was done for more responsible governance of European science and technology, called into question the fundamentals of a boundary-setting approach. In the report, prepared by the 'Democratising expertise and establishing scientific reference systems' working group (Liberatore 2001), the question of a search for greater harmonization between science and society (i.e. more responsible science) does not begin with a diagnosis of a conflict between the two areas; rather, it acknowledges the need to transform scientific practice by making a problem out of its abilities and its regulatory authority. Certain theoretical approaches to the issue of governance and risk perception have brought into relief the endemic uncertainty systematically facing the science of risk (Beck 1986

[1992]; Giddens 1990), the inevitable influence of non-epistemological values on the constitution of scientific knowledge (Douglas 2000; Longino 1990), the constitutive nature of the convergence of science and political interest in appraisal and regulation processes (Jasanoff 1990; Wynne 2002) and, in short, the way these factors intrinsic to scientific activity determine social responses to innovation.

**4. New attempts and old inertias: integration and RRI**

The boundary-setting approaches underscored above have been utterly useless in responding satisfactorily to controversy about and social resistance to technological innovations. And there doesn't seem much point in appealing to supposedly evident scientific "facts", as agro-food biotechnology regulation dynamics in the EU would appear to confirm, where a broad range of member countries, including Germany and France, continue to prohibit farmers from growing transgenic varieties previously approved at community level in their territory for scientific reasons, which shows it is impossible to determine safety levels for this type of innovation, bound to interact in hyper-complex systems, without recurring to certain assumptions, or evaluative criteria (Bøhn et al. 2012; Tosun 2014; Wickson and Wynne 2012).

Motivated by increasing institutional awareness of these problems, European institutions have begun to see social responsibility issues concerning science in a more integrative way. In 2004, the EC emphasized the need to take account of social and ethical issues associated with the then incipient nanotechnologies from the beginning, i.e. as a constitutive part of their development:

> Nanotechnology must be developed in a safe and responsible manner. Ethical principles must be adhered to and potential health, safety or environmental risks scientifically studied, also in order to prepare for possible regulation. Societal impacts need to be examined and taken into account. Dialogue with the public is essential … (EC 2004, p. 3). [Extract]

However, this sort of approach still seems to be formulated on the basis of a clear differentiation between science and society. Although perhaps not in essentialist terms, this differentiation is still alive and kicking to the extent that this new type of proposal subordinates the transformational potential of integration to the socio-economic logic of scientific policy. As the EC put it: 'For Europe to become the most advanced knowledge society in the world, it is imperative that legitimate societal concerns and needs concerning science and technology development are taken on board' (EC 2007, p. 4). In the end, as John Dalli, ex-European Commissioner for Health and Consumer Policy said (2010-2012), 'it is important … to convince citizens of the benefits of … innovative products' (Dalli 2010, p. 2).

The EC called for 'inclusive' risk governance that would promote 'a dialogue among experts, stakeholders and decision-makers' (EC 2009, p. 7). However, such integration is based on a clear functional divide between scientific (assessment) and social and political aspects (management) of the governance process: 'Risk management can be understood as a process of weighing the outcome of the risk assessment with political and socio-economic factors' (EC 2009, p. 11). This is an example of the way European regulatory institutions limit the scope of what we might conceive, debate and

implement with regard to social and technical safety in the name of the "objectivity" of risks (Rodríguez 2014).

While it is true the dynamics of science and technology are opening up to a growing variety of concerns and players, it is also true that the boundary-setting basis of these policies, in the name of the "objectivity" of the problems, has worked as a safeguard for the dynamics of technological innovation, by establishing limits of legitimacy—on the basis of that very "objectivity"—for any approach implying the subversion of the established social and technical order. This is why responsible innovation policy seems largely to have resisted critical scrutiny of the basic motives, commitments and visions of scientific and technological innovation dynamics, as a report issued in 2007, commissioned by the EC, pointed out (Felt et al. 2007).

In line with this vision, and driven in particular by the acknowledgement of the partial failure of responsible science and technology policy as regards the rather erratic social and political acceptance of transgenic plants in EU territory, it seems that European institutions have acknowledged the need to take a broader, more complex approach to responsibility, not centered on the management of technological innovations *per se*—valued in accordance with "objectively" delimited risks and problems and a series of assumptions about competitiveness, wellbeing and progress maintained on the margin of what may be called into question, but rather on 'the whole innovation process' (von Schomberg 2015, p. 2).

This would happen if the EU adopted the RRI approach, as a means of modulating R&D activities of FP8 (2014-2020), or 'Horizon 2020', in line with a heterogeneous research model, in which 'all societal actors (researchers, citizens, policy makers, business, third sector organisations etc.) … work together during the whole research and

innovation process in order to better align both the process and its outcomes with the values, needs and expectations of European society' (EC 2013b, p. 4). An RRI approach would seem to require a justification of technological innovations in an open debate that includes the detailed consideration and appraisal of its benefits, or 'right impacts' (von Schomberg 2013). So it involves making contingent the principles, interests, visions and assumptions underlying institutional innovation systems, used to appraise innovations in terms of their expected benefits. The Head of Unit for 'Nano and Converging Sciences and Technologies' of the EC Christos Tokamanis saw things this way in 2011. He said that, unlike the way the question of nanotechnology had originally been approached (e.g. EC 2004), 'nanotechnology is not simply about creating or improving products' (Tokamanis 2011, p. 10), but something that needed to be looked at as a 'socio-political project', in the sense that the economic, social, ethical and cultural dimensions should be exposed to public debate and scrutiny as a constitutive part of innovation dynamics (Tokamanis 2011, p. 10).

Accepting scientific and technological innovation as a heterogeneous project means calling into question, in principle, the boundary-setting image of science—both in its essentialist aspect and the way it is used—by making scientific activity permeable to a broad range of considerations, in accordance with which innovation dynamics would become more contingent, or more debatable. Even so, some scepticism about this programmatic principle would not come amiss. Detailed analysis of the way European scientific policy has evolved in recent decades shows that the increasing radicalization of the arguments in favour of base-line responsible innovation does not entail a proportional transformation in the design of, and demand for, scientific and technological practice, much more oriented towards satisfying the requirement of a

knowledge-based, hyper-competitive society, and to integrating industrial players in research (Rodríguez et al. 2013). The potential of institutionally sponsored exercises in public participation in technological development influencing technological developments is clearly limited by the objectives, values and interests that guide the political and economic dynamics involved in promoting and regulating innovation (Sykes and Macnaghten 2013).

These examples of constraints on the social and technical contingency vindicated by the RRI reforms should force us to relativize what they can achieve, as they do not represent issues that might be termed accessory, but are rather constitutive tensions whose expression is kept at arm's length by a type of approach that continues with the old triumphalism, despite this no longer being formulated in boundary-setting or linear terms. Tensions are kept at bay through formulations that still assume the basic non-problematization between the possibility of satisfying certain "social challenges" (such as climate change, the energy supply or the scarcity of natural resources) and the commitment to economic competitiveness. In the EC's opinion: 'win-win policies designed to stimulate the economy and tackle major societal challenges are both viable and desirable' (EC 2010, p. 6).

The problem-oriented approach,[4] which is at the heart of 'Horizon 2020', and of the RRI approach itself (described in accordance with attempts to find a precise mean between research and social expectations), raises somewhat ambiguous feelings. In line with its orientation towards social and environmental problems that transcend the purely economic, it potentially has the ability to open innovation processes up to a

[4] Also characteristic of a tendency that transcends the exclusively European zone (e.g. OECD 2012).

variety of perspectives and players, in accordance with which research objectives and procedures would be reformulated (see, in this respect, the definition of RRI given above). However, this approach could mean extending still further the progressive "techno-scientification" of the world and the way we understand and try to solve its problems. The Lund Declaration (2009), the result of a massive congress on research and innovation held in Lund (Sweden in 2009) (commissioned by the then Swedish Presidency of the Council of the EU), where the conceptual foundations were laid for the "Grand Challenges" approach adopted in the EU's science policy,[5] establishes that

> Meeting the Grand Challenges will be a prerequisite for continued economic growth and for improved chances to tackle key issues. It will involve women and men on equal terms in the development of society and cut across social, religious, generational and cultural obstacles bringing about new possibilities and increase the well-being and quality of life for all. (Lund Declaration 2009, p. 41) [Extract]

Here, science is conceived as a sort of "bringer of peace" to all kinds of social and cultural conflicts, and is expected to provide solutions for them all. We feel this is to give a hyper-triumphalist image of science, where the fundamental tension between economic and social objectives we refer to in this article is settled in more participative, or socially responsible terms, but ultimately dependent on science as the main facilitator of progress.

[5] EC-CORDIS: Swedish presidency: research must focus on grand challenges: http://cordis.europa.eu/news/rcn/31013_es.html (accessed 23 June 2015).

## 5. Conclusions

We have discussed the progressive radicalization in recent decades of responsible innovation policies in the EU in light of the social and institutional tensions and dynamics underlying this evolution, marked by attempts to juggle demands for socially more responsible science and technology and the subordinate nature of R&D activities to economic policy.

In this sense, the scope and significance of responsible innovation policies and the way they evolve depend on how they are appraised and how the different objectives, interests and demands associated with scientific and technological progress relate to each other in our societies. We have seen, for instance, that generally speaking, European research policy has tended to give preference to economics-and industrialist-based interests, criteria and conceptions of innovation, something that has been expressed and justified in terms of a boundary separating science and society, formulated throughout the development or responsible innovation policies both in essentialist and functionalist terms.

However, the most recent proposals for responsible innovation in the EU, formulated in the context of the last R&D Framework Programme, or 'Horizon 2020', and covered by the RRI concept, seem to pose the question of social responsibility of science and technology in more relational, or systemic term, when arguing for the open, or debatable, nature of the entire innovation process, including issues such as values, motivations, expectations and expected benefits.

RRI aspires to open up to public scrutiny issues that are constitutive of innovation which have tended to be proof from the social context, and this gives to this particular

viewpoint the virtue of facilitating other, more alternative visions and futures for science and its relations with society and nature. Despite RRI's innovative approach to the tensions between the economics-based imperative of innovation and social responsibility through a relational, or non-boundary-marking focus, we must continue to be aware of potential inertias, asymmetries of power and basic priorities that may limit the constitution of more radically responsible social and technical realities and futures. In any case, RRI and its mission to make innovation a more contingent process, enables us to make explicit such dynamics and constraints, which may in itself be considered a relevant contribution.

**Acknowledgements**

This paper is based on research supported by the Spanish Ministry of Economy and Competitiveness under grant FFI2012-33550 (Rodríguez and Ibarra), and the Basque Government's Department of Education, Language Policy and Culture under grant IT644-13 (Eizagirre).

## References

Bauer, Martin (ed.) (1995), *Resistance to New Technology: Nuclear Power, Information Technology and Biotechnology*, Cambridge: Cambridge University Press.

Beck, Ulrich (1986), *Risikogesellschaft: Auf dem Weg einem andere Moderne.* Frankfurt: Suhrkamp. Translated into English by Mark Ritter: *Risk Society: Towards a New Modernity*, London: Sage. 1992.

Bell, Daniel (1962), *The End of Ideology*, Cambridge: Harvard University Press.

Bøhn, T., R. Primicerio and T. Traavik (2012), 'The German ban on GM maize MON810: scientifically justified or unjustified?', *Environmental Sciences Europe*, **24** (22), 1-7.

Black, Jeremy M. (2013), *War and Technology*, Bloomington and Indianapolis: Indiana University Press.

Bush, Vannevar (1945), *Science: The Endless Frontier*, Washington, D.C.: NSF.

Busquin, Philippe (2003), 'Foreword: Building a knowledge-based Europe – our common challenge', in EC, *The Overall Socio-Economic Dimension of Community Research in the Fifth European Framework Programme – A Synthesis Report on the Integration of the Socio-Economic Related Research Activities of the European Community (1998–2002)*, (EUR 20577), Luxembourg: Office for Official Publications of the European Communities, p. 6.

Cozzens, Susan E. and Jameson Wetmore (eds.) (2010), *Nanotechnology and the Challenges of Equity, Equality and Development*, New York: Springer.

Council of the European Union (2000), *Presidency Conclusions. Lisbon European Council 23 and 24 March 2000*.

Council of the European Union (2002), 'Council Decision of 30 September 2002 adopting a specific programme for research, technological development and demonstration: 'Integrating and strengthening the European Research Area' (2002-2006)', (2002/834/EC), in: *Official Journal of the European Communities*, 29.10.2002, L 294, Brussels, pp. 1-43.

Dalli, J. (2010), 'Innovation needs to be in tune with the broad values of society' (SPEECH/10/741). EuropaBio Event: The Role of Biotechnology in Europe's Responsible Innovation. Brussels, 9 December 2010.

Dennett, Daniel C. (1995), *Darwin's Dangerous Idea: Evolution and the Meanings of Life*, New York: Simon & Schuster.

Douglas, H. (2000), 'Inductive risk and values in science', *Philosophy of Science*, **67** (4), 559-79.

EC (1992), *Towards Sustainability: A European Community Programme of Policy and Action in Relation to the Environment and Sustainable Development*, COM 92 (23), Vol. 2, Brussels.

EC (2000), *Towards a European Research Area*, COM(2000) 6 final, Brussels, 18.1.2000.

EC (2001), *European Governance: A White Paper*, COM(2001) 428 final, Brussels, 25.7.2001.

EC. (2002), *Science and Society: Action Plan*, Luxembourg: Office for Official Publications of the European Communities.

EC (2003), *The overall socio-economic dimension of community research in the fifth European framework programme – A synthesis report on the integration of the socio-economic related research activities of the European Community (1998–2002)*, (EUR 20577), Luxembourg: Office for Official Publications of the European Communities.

EC. (2004), *Towards a European Strategy for Nanotechnology*, Luxembourg: Office for Official Publications of the European Communities.

EC (2005), *Social Values, Science and Technology*, Special Eurobarometer 225 / Wave 63.1 – TNS Opinion & Social, Brussels.

EC. (2007), *Work Programme 2007 – Capacities, Part 5: Science in Society* (C(2007)563 of 26.02.2007). The Seventh Framework Programme, Brussels.

EC. (2009), *Goverscience Seminar on Inclusive Risk Governance*. (EUR 23910), Luxembourg: Office for Official Publications of the European Communities.

EC. (2010), *A Rationale for Action – Accompanying document to the Europe 2020 Flagship Initiative Innovation Union*, COM(2010) 546, Brussels, 6.10.2010, SEC(2010) 1161 final.

EC .(2011), *Horizon 2020 – The Framework Programme for Research and Innovation*, 30.11.2011, COM(2011) 808 final, Brussels.

EC. (2013a), *Innovation Union – A pocket guide on a Europe 2020 initiative*, Luxembourg: Publications Office of the European Union.

EC. (2013b), *Horizon 2020, Work Programme 2014–2015: 16. Science with and for Society*, C(2013) 8631, Brussels.

Elizalde, José (1998), 'General Introduction: ELSA in F.P. 4', in European Commission, *E(thical), L(egal) and S(ocial) A(spects) of the Life Sciences and Technologies Programmes of Framework Programme IV. Catalogue of Contracts*, EUR 18309, Brussels, pp. 11-14.

European Parliament and Council of the European Union (2002), 'Regulation (EC) No. 2321/2002 of the European Parliament and of the Council of 16 December 2002 concerning the rules for the participation of undertakings, research centres and universities in, and for the dissemination of research results for, the implementation of the European Community Sixth Framework Programme (2002–2006)', *Official Journal of the European Communities*, 30.12.2002, L 355, Brussels, pp. 23-34.

Felt, Ulrich, Brian Wynne, Michael Callon, Marian Eugenia Gonçalves, Sheila Jasanoff, Maria Jepsen, Pierre-Benoît, Joly, Zdenek Konopasek, Stefan May, Claudia Neubauer, Arie Rip, Karen Siune, Andy Stirling and Mariachiara Tallacchini (2007), *Taking*

*European Knowledge Society Seriously*, Luxembourg: Office for Official Publications of the European Communities.

Fukuyama, Francis (2002), *Our Posthuman Future: Consequences of the Biotechnology Revolution*, New York: Farrar, Straus, and Giroux.

Giddens, Anthony (1990), *The Consequences of Modernity*, Stanford, CA: Stanford University Press.

Godin, Benoît (2009), *The Making of Science, Technology and Innovation Policy: Conceptual Frameworks as Narratives, 1945-2005*, Montreal: Centre Urbanisation Culture Société.

Godin, Benoît (2015), *Innovation Contested. The Idea of Innovation Over the Centuries,* London: Routledge.

Hajer, Maarten A. (1995), *The Politics of Environmental Discourse: Ecological Modernization and the Policy Process*, Oxford: Clarendon Press; New York: Oxford University Press.

Jasanoff, Sheila (1990), *The Fifth Branch: Scientific Advisors as Policymakers*, Cambridge: Harvard University Press.

Klemmensen, Børge, Sofie Pedersen, Kasper R. Dirckinck-Holmfeld, Anneli Marklund and Lars Rydén (2007), *Environmental Policy – Legal and Economic Instruments*, Uppsala: Baltic University Press.

Lane, R. (1966), 'The decline of politics and ideology in a knowledgeable society', *American Sociological Review*, **31** (5), 649-662.

Liberatore, Angela (2001), *Democratising Expertise and Establishing Scientific Reference Systems*. Report of the Working Group 1b, White Paper on Governance, Work Area 1:

Broadening and Enriching the Public Debate on European Matters. Brussels: European Commission.

Longino, H.E. (1990), 'Biological effects of low level radiation: values, dose-response models, risk estimates', *Synthese*, **81** (3), 391-404.

Lund Declaration (2009), 'Europe Must Focus on the Grand Challenges of our Time', in Uno Svedin (Rapporteur), *New Worlds – New Solutions. Research and Innovation as a Basis for Developing Europe in a Global Context* (The Swedish EU Presidency Conference), Lund 7-8 July 2009, Sweden. Final Report, pp.40-41.

Marklund, Göran, Nicholas S. Vonortas and Charles W. Wessner (eds.) (2009), *The Innovation Imperative: National Innovation Strategies in the Global Economy*, Cheltenham: Edward Elgar.

Merton, R. (1942), 'A note on science and democracy', *Journal of Legal and Political Sociology*, **1** (1/2), 115-126.

Nelkin, Dorothy (1977), *Technological Decisions and Democracy*, Beverly Hills, Calif.: Sage.

OECD (1968), *Gaps in Technology: General Report*, Paris: OECD.

OECD (1971), *The Conditions of Success in Technological Innovation*, Paris: OECD.

OECD (1972a), *The Research System*, Paris: OECD.

OECD (1972b), *Science, Growth and Society: A New Perspective*, Paris: OECD.

OECD (1980), *Technical Change and Economic Policy*, Paris: OECD.

OECD (1989), *Renewable Natural Resources: Economic Incentives for Improved Management*, Paris: OECD.

OECD (1991a), *Choosing Priorities in Science and Technology*, Paris: OECD.

OECD (1991b), *Technology in a Changing World*, Paris: OECD.

OECD (1992), *Technology and the Economy: the Key Relationships*, Paris: OECD.

OECD (1996), *The Knowledge-Based Economy*, Paris: OECD.

OECD (1999), *Managing Innovation Systems*, Paris: OECD.

OECD (2005), *Governance of Innovation Systems*, Paris: OECD.

OECD (2012), *Meeting Global Challenges through Better Governance*, Paris: OECD.

Owen, Richard, John Bessant and Maggy Heintz (eds.) (2013), *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*, Chichester: Wiley.

Pellizzoni, Luigi and Marja Ylönen (eds.) (2012), *Neoliberalism and Technoscience: Critical Assessments*, Farnham; Burlington, VT: Ashgate.

Perrow, Charles (1984), *Normal Accidents: Living with High-Risk Technologies*, New York: Basic Books.

Polanyi, M. (1962), 'The republic of science: its political and economic theory', *Minerva*, **1** (1), 54-73.

Ridley, Matt (2010), *The Rational Optimist: How Prosperity Evolves*, New York: Harper.

Rodríguez, H. (2014), 'From objective to constituted risk: an alternative approach to safety in strategic technological innovation in the European Union', *Journal of Risk Research*. DOI: 10.1080/13669877.2014.940596.

Rodríguez H, E. Fisher and D. Schuurbiers (2013), 'Integrating science and society in European Framework Programmes: trends in project-level solicitations', *Research Policy*, **42** (5),1126–1137.

Sandel, Michael J. (2007), *The Case Against Perfection: Ethics in the Age of Genetic Engineering*. Cambridge, MA: Belknap Press of Harvard University Press.

Sarewitz, Daniel (1996), *Frontiers of Illusion. Science, Technology and the Politics of Progress*, Philadelphia: Temple University Press.

Schumacher, Ernst F. (1973), *Small is Beautiful: Economics as if People Mattered*, New York: Harper &Row.

Shrader-Frechette, Kristin (1980), *Nuclear Power and Public Policy: The Social and Ethical Problems of Fission Technology*, Dordrecht: Springer.

Shrader-Frechette, Kristin (2007), *Taking Action, Saving Lives: Our Duties to Protect Environmental and Public Health*, Oxford; New York: Oxford University Press.

Stančič, Zoran ( 2007), 'Foreword', in Mary Braithwaite, Renate Fries, Thomas Zadrozny, Nathalie Wuiame, Miriam Anasagasti-Corta and Nigel Ings, *Integrating Science in Society Issues in Scientific Research: Main Findings of the Study on the Integration of Science and Society Issues in the Sixth Framework Programme* (Report to the European Commission), EUR 22976, Luxembourg: Office for Official Publications of the European Communities, p. 1.

Sykes, Kathy and Phil Macnaghten (2013), 'Responsible Innovation: opening up dialogue and debate', in Richard Owen, John Bessant and Maggy Heintz (eds.), *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*, Chichester: Wiley, pp. 85-107.

Tokamanis, Christos (2011), 'Nanotechnology becomes a socio-political project' (Interview), in Matteo Bonazzi (ed.), *Successful European Nanotechnology Research. Outstanding Science and Technology to Match the Needs of Future Society*, Luxembourg: Publications Office of the EU, pp. 9-12.

Tosun, J. (2014), 'Agricultural biotechnology in Central and Eastern Europe: determinants of cultivation bans', *Sociologia* Ruralis, **54** (3), 362-381.

UN. (1972), *Declaration of the United Nations Conference on the Human Environment*. Stockholm, 16 June 1972.

von Schomberg, René (2013), 'A Vision of Responsible Research and Innovation', in Richard Owen, John Bessant and Maggy Heintz (eds.), *Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society*, Chichester: Wiley, pp. 51-74.

von Schomberg, René (2015), 'From 'Responsible Development of Technologies' to Responsible Innovation'. Adapted from J. Britt Holbrook and Carl Mitcham. *Ethics, Science, Technology, and Engineering: An International Resource (ESTE2)*, 2E. © 2015 Gale, a part of Cengage Learning, Inc.

Wales, C. and G. Mythen (2002), 'Risky discourses: the politics of GM Foods', *Environmental* Politics, **11** (2), 121-144.

Weinert, Friedel (2009), *Copernicus, Darwin & Freud: Revolutions in the History and Philosophy of Science*, Chichester/Malden: Wiley-Blackwell.

Wickson, F. and B. Wynne (2012), 'Ethics of science for policy in the environmental governance of biotechnology: MON810 Maize in Europe', *Ethics, Policy & Environment*, **15** (3), 321-340.

Winner, Langdon (1977), *Autonomous Technology*, Cambridge, Mass.: MIT Press.

Wynne, B. (2002), 'Risk and environmental as legitimatory discourse of technology: reflexivity inside out?', *Current Sociology*, **50** (3), 459-477.