



Project acronym: Res-AGorA

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Deliverable D3.7

Final Synthesis and Lessons Report.
Res-AGorA empirical programme of case studies, transversal lessons and illustrations to the Responsibility Navigator

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Res-AGorA – A brief project overview

The EU seeks to become a genuine Innovation Union in 2020 striving for excellent science, a competitive industry and a better society. However, it seeks to do so in a responsible way, i.e. without compromising on sustainability goals or ethically acceptable and socially desirable conditions. What exactly constitutes responsibility is, and will be, contested. However, the process by which responsibility is negotiated and institutionalized needs to be governed appropriately. Europe thus needs to develop a comprehensive **governance framework** for Responsible Research and Innovation (RRI). This is the major goal of Res-AGorA.

The Res-AGorA governance framework builds on existing RRI governance practices across and beyond Europe. It is open, transparent, reflexive and adaptable to enable the inherent tensions in all governance of RRI to be actively addressed by procedural means aiming to facilitate constructive negotiations and deliberation between diverse actors.

The main final outputs of the project are a **Responsibility Navigator** which is a set of concrete RRI governance principles and illustrations designed to facilitate related debate, negotiation, learning and decision making in a constructive and productive way, and a **Co-Construction Method** which is a collaborative workshop methodology designed to systematically support and facilitate the practical use of the Responsibility Navigator with stakeholders.

Res-AGorA achieved its objectives through a set of work packages providing an empirically grounded comparative analysis of a diverse set of existing RRI governance arrangements and their theoretical/conceptual underpinnings in different situations (WP2 and WP3), a continuous monitoring of RRI trends and developments in selected countries (WP5) and, based on the cumulative insights derived from these work packages, the central building blocks and procedures of a governance framework for RRI (WP4), co-constructed with stakeholders.

The Res-AGorA governance framework delivered cognitive and normative guidance that can be applied flexibly in different contexts. Res-AGorA will thus have direct impact on RRI practices (science, industry, policy), and strategic impact in terms of the political goals (Horizon 2020) and competitiveness (Lead Market through growing acceptance of new technologies).

Res-AGorA ensured intensive stakeholder interaction and wide dissemination of its tangible and intangible outputs in order to maximise impact, including comprehensive and interactive stakeholder engagement, liaisons with other ongoing RRI activities funded by the SiS (Science in Society) Work Programme, and a final conference.

For more information on project results and activities, please visit www.res-agora.eu.

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Preface: Objectives of the deliverable

This Deliverable D3.7 is the summary of activities, outputs and outcomes of the empirical Work Package 3 (WP3) within the Res-AGorA project.

The main activity of WP3 was to deliver a suite of case studies in three different stages. The choice of the cases was informed by a concept of governance situations in order to ensure the variety of challenges and actor constellations when governing research and innovation in different contexts (Deliverable 2.3). All case studies are available on the web (<http://res-agera.eu/case-studies/>). Overarching lessons for all cases have been drawn in two analytical reports, Deliverable D3.5 and D3.6. The key lessons of these analyses as well as illustrations based on those lessons have finally informed the **Responsibility Navigator** and the **Co-Construction Method** as main outputs of Res-AGorA.

WP3 has been a collective exercise, only possible through the case work of a large number of people. Special thanks therefore goes to the Res-AGorA case-workers who have made this report possible:

Simone Arnaldi, Daniel Bachlechner, Davy van Doren, Jakob Edler, Sally Gee, Kerstin Goos, Guido Gorgoni, Erich Griessler, Pierre-Benoit Joly, Evgeny Klochikhin, Alexander Lang, Timo Leimach, Ralf Lindner, Allison Loconto, Alessia Muratorio, Elena Pariotti, Michael Pero, Sally Randles, Danielle Ruggiu, Johan Söderberg, Kalle Stahl Nielsen, Elise Tancoigne, Morten Velsing Nielsen, and Bart Walhout.

Manchester, December 2, 2015

1 Introduction

The EU seeks to become a genuine **Innovation Union** in 2020 striving for excellent science, a competitive industry and a better society without compromising on sustainability goals or ethically acceptable and socially desirable conditions. For a number of years, there is a debate emerging on how best to translate these broad aims into **principles for responsible research and innovation**. Indeed, across Europe a number of different explicit frameworks of Responsible Research and Innovation¹ have appeared. Most recently, in November 2014, a EU conference on “Science, Innovation and Society: achieving Responsible Research and Innovation” held under the Italian Presidency adopted the “Rome Declaration on Responsible Research and Innovation in Europe”. This declaration is one example of a concrete manifestation of what responsible research and innovation should mean. However, it is not, and cannot be, the definite final manifestation for all different contexts at different political and organisational levels across and within Europe, as the very essence of what is responsible in research and innovation is contested and will need constant re-negotiation and deliberation.

This fluid and contested nature of responsible research and innovation is exactly the starting point and essence of Res-Agora. Rather than trying to construct yet another framework specifying the normative content of what RRI should be, Res-Agora offered to develop and propose a **framework** for guiding the process of governing towards Responsible Research and Innovation for Europe, where the normative content is negotiated by actors themselves as part of a continual process of reflexive, anticipative, responsive and impactful adaptation of research and innovation to changing societal problems. The aim of Res-AGorA has been to design a framework of principles intended to harness the self-regulatory capacities and capabilities of actors within Europe. This framework will help actors to understand their responsibility challenges and to design, negotiate and implement their own context specific understanding of responsible research and innovation within a broader set of democratic and other normative principles across the EU.

Res-AGorA has developed this framework in the form of governance principles, codified in the **Responsibility Navigator** and supported by the **Co-Construction Method**. The former provides a set of ten principles for the governance process towards responsibility in research and innovation, while the latter is a method to help actors to understand the responsibility challenge and design adequate processes.

The development of the framework was based on a literature review, a suite of 26 case studies, country overviews, a scientometric analysis and five co-construction workshops with stakeholders. This report is the final deliverable of WP3 which conducted and analysed the case studies and derived overarching lessons out of those cases, feeding directly into the development of the **Co-Construction Method** and **Responsibility Navigator**.

¹ When we speak of Responsible Research and Innovation (RRI) we refer to explicit, codified frameworks. By contrast, when we speak of responsible research and innovation (rri) we refer to de-facto processes and principles of responsibility which are in-the-making, that is the many ways that actors interpretations of responsibility are already or historically embedded into practices and governance processes.

This report is a concise summary of the main activities and lessons of WP3. It summarises the logic and extent of our case work (section 2) as well as the main lessons across the cases (section 3) (for more detail see Deliverable 3.6)². It then displays the principles that have been developed on the basis of the case work and finally draws some overall lessons on lesson drawing (sections 4 and 5 respectively).

² Randles, S, Gee, S., Edler, J. (2015): 'Governance and Institutionalisation of Responsible Research and Innovation in Europe : Transversal Lessons from an extensive programme of case studies: Stakeholder Report' March 2015, available at: http://res-agera.eu/assets/ResAGORA-lessons-Stakeholder-Report_final_formated.pdf

2 The empirical basis – Logic and extent of case work

From the outset, the basic idea of the empirical work in Res-AGorA has been to inform the development of the governance framework in order to capture a broad variety of situations and challenges for the development of responsible research and innovation – and to guide the governance processes to support this development.

Logic of case selection and coverage

Originally, the idea in our proposal had been to conduct case work in five different techno-scientific domains. This was based on the initial assumption that it is the distinct scientific, innovation and social properties of those domains that would be the main differentiators for the governance challenges towards RRI. However, once we had developed a systematic account of the dimensions which shape the context for governance of responsible research and innovation (Deliverable D3.5)³, the research team, when analysing the findings of the case studies came to the view that techno-scientific domain is just one among many different dimensions to take into account. Looking across our early cases in different domains, we realised that it was not so much the domain itself but other characteristics such as the level of uncertainty, the heterogeneity of actors involved in and affected by the research and innovation process, the closeness to market, and so on, that accounted for the noteworthy differences and similarities across the cases. All of those characteristics can differ greatly *within* a given techno-scientific domain, while they do not differ systematically *between* techno-scientific domains. Therefore, we decided not to develop the empirical programme according to the techno-scientific domains, but according to the need to cover a sufficient variety of situations in order to be of maximum use for the Res-AGorA stakeholder community.

Understanding and capturing variety of situations

To bring order to the selection and coverage of cases in WP3, as part of the conceptual work in WP 2, we developed a concept to characterise different situations as a backdrop for the governance challenges towards RRI (Deliverable D2.3)⁴. This governance situations paper differentiated substantive and material dimensions on the one hand and procedural dimensions on the other (Table 1 below). It subsequently helped us to select the empirical cases and to differentiate the lessons between the more generic and those that apply in specific situations. It also informed the development of the Co-Construction Method.

³ Available at: http://res-agera.eu/assets/ResAGORA-case-lessons-report-D-3_5-final.pdf

⁴ Edler, J., Randles, S., Gee, S., Kuhlmann, S., Walhout, B (2014): Governance Situations and Challenges. Conceptualising variety to underpin a socio-normative RRI governance framework, Manchester, Twente, Karlsruhe, available at: http://res-agera.eu/assets/Res-AGorA_del_2.3.pdf

Table 1: Dimensions of situations as basis for selection of cases

Substantive and material dimensions	Procedural dimension
<ul style="list-style-type: none"> ▪ <i>Actor Landscape: Range and variety of actors involved</i> ▪ <i>Locality vs globality</i> ▪ <i>Research / emerging technologies vs innovation vs. orientation along societal challenges⁵</i> ▪ <i>Techno-science domains/ nature of the underlying technology</i> ▪ <i>Nature and level of uncertainty about:</i> <ul style="list-style-type: none"> ▪ <i>societal consequences of knowledge/ technology/ innovation</i> ▪ <i>uptake of innovation in markets , consequences</i> ▪ <i>current / upcoming regulatory environment for an innovation</i> ▪ <i>Nature of the contestation (material and / or normative)</i> ▪ <i>Institutional and country settings (cultural, economic, institutional, regulatory, scientific and economic)</i> ▪ <i>Level of RRI intervention (Global/EU/national, hybrid networks, organizational level)</i> 	<ul style="list-style-type: none"> ▪ <i>Modes of actor mobilisation</i> ▪ <i>Resource provision (money, people, knowledge)</i> ▪ <i>Capacity building (incl knowledge)</i> ▪ <i>Main source and origin of responsabilisation/lead</i>

The case study work followed an analytical model that was developed in WP 2 informed by the first stage of pilot case studies. Both the analytical model and the different dimensions of situations were translated into a guiding template for the second and third stages of cases.⁶

Three stage case analysis

Overall, Res-AGorA selected and analysed 26 cases in three stages⁷. The selection of cases followed a rigorous internal commissioning process, co-ordinated by the Manchester team and involving all consortium partners. The field work was conducted with consultation between the case workers, the Manchester/Twente teams, and other interested consortium partners; interim reporting and presentations ensured that insights could feed into other work elements across the Res-AGorA programme in parallel. Hence, results from the case studies fed into the elaboration of the Research Model, the drafting of the Framework principles, and the development of the co-constructive stakeholder workshops. Individual case reports were developed iteratively and sequentially across three stages, with all final versions shared across the wider team via the Res-AgorA website. In this way, each stage followed a systematic process of establishing the case-studies according to an increasingly specified ‘Research Model’.

The first stage was inductive, the aim being to learn and observe from a first round of ‘experimental’ case work that informed the subsequent stages. Eight cases were selected in Stage 1 to explore different basic understandings of responsibility and its contestation and operationalization in different research and innovation ‘situations’ (Table 2).

⁵ This dimensions has been expanded during the case process, originally, there was a distinction between research and innovation, but this has expanded into the three pillars of H2020, research/emerging technologies, innovation, societal challenges.

⁶ For more detail on the commissioning process for the cases and the interaction towards analysis please see Deliverable D3.6, available at: http://res-adora.eu/assets/Res-AgorA_321427_Del_3-6_final.pdf

⁷ The cases can be found at: <http://res-adora.eu/case-studies/>

Table 2: stage 1 cases (pilot cases): September – December 2013, 8 cases

Integration of RRI in policy advice – the case of synthetic biology assessments (health; medical; food; agriculture; energy). Author: Davy van Doren, Fraunhofer ISI
RRI governance in Research Infrastructures (material sciences). Author: Mickael Pero, Fraunhofer ISI
Fracking in Austria (energy and carbon capture). Author: Alexander Lang, IHS Vienna
Nanosafety governance in the Netherlands (nanotechnology). Author: Bart Walhout, University of Twente
Responsibilisation phenomena relating the EC Code of conduct for Responsible Nanosciences and Nanotechnologies Research (health; medical; generic technology). Authors: Daniele Ruggiu, Elena Pariotti, Guido Gorgoni, Simone Arnaldi, University of Padua
Occupational health protection in standardisation experiences as an example of self-regulation (health; medical). Authors: Alessia Muratorio, Guido Gorgoni, Elena Pariotti, Simone Arnaldi, University of Padua
When ‘responsible’ becomes ‘irresponsible’: biofuels in the USA and Brazil (energy; agriculture; food). Authors: Sally Gee, Jakob Edler, University of Manchester
RRI in Russia: where society is silent and the state controls the floor. Author: Evgeny Klochikhin, University of Manchester [not yet published]

The successive selection of cases sought to ensure that the empirical research covered the breadth of situations in which organisational actors and individuals are confronted with rri (*de-facto* responsible research and innovation)⁸ challenges. In stage 2 (see Table 3) we focused on situations that a variety of responsibility claims and their contestation and heterogeneous actor arrangements (actor constellations and governance instruments), with greater attention paid to using the Research Model to frame the case enquiry and presentation of findings.

Table 3: stage 2 cases (development): February - April 2014, 9 cases

The responsabilisation and regulation of garage innovation open source 3D printing (advanced manufacturing). Author: Johan Söderberg, IFRIS
Linking responsible research and innovation on the farm: The case of Participatory Guarantee Systems (agriculture; food). Author: Allison Loconto, IFRIS
The responsabilisation and regulation of garage innovation: DIY-drug innovation in the psychonaut subculture (health). Author: Johan Söderberg, IFRIS
‘Fracking in Austria and the UK – A comparative study’ (geo-engineering; energy). Author: Alexander Lang, IHS Vienna
Responsible -> Irresponsible -> Responsible? Contestation & the re-design of governance instruments for US bioethanol (energy; agriculture; food; livestock). Authors: Sally Gee, Jakob Edler, Manchester University.
Anchoring knowledge transfer activities. The EC CoC and normative anchor points in laboratory practices in Italy (nano-toxicology). Authors: Simone Arnaldi, Alessia Muratorio, University of Padua
Horizontal Foresight to address societal challenges in Danish priority-setting for strategic research. Author: Morten Velsing Nielsen, Danish Board of Technology
Integration of RRI in policy advice– A review of the UK synthetic biology roadmap (health; medical; food; agriculture; energy). Author: Davy van Doren, Fraunhofer ISI
Non-Compulsory ethics committees at Austrian universities (cross-disciplinary). Author: Erich

⁸ See footnote 1 above.

Griessler

Xenotransplantation (health: medical). Author: Erich Greissler

For the third and final stage we included cases to cover situations that were not fully dealt with in earlier stages (Table 4), focusing mainly on organisations central to the development of rri such as multi-national corporations; universities, research funding councils and institutes and engineering professional associations.

Table 4: stage 3 cases (completion, filling gaps): June 2014 – February 2015, 9 cases

Responsibility and reflexivity in engineering: professional societies and codes of ethics (engineering).

Authors: Simone Arnaldi, Alessia Muratorio, University of Padua

Institutionalising RRI – the case of a large research organisation. Authors: Kerstin Goos, Ralf Lindner, Fraunhofer ISI

Governance structures affecting data protection in advanced manufacturing – how much room does Germany’s ambition to lead the fourth industrial revolution leave for RRI? (advanced manufacturing). Authors: Daniel Bachlechner, Timo Leimbach, Fraunhofer ISI

‘Practicing RRI in NanoNextNL’ (nanotechnology). Author: Bart Walhout, University of Twente

Critical Organisation-types, The ‘Good University’. Author: Sally Randles, University of Manchester

Critical organisations: Research Councils of UK. Authors: Kalle Stahl Nielsen, Sally Gee, Jakob Edler, University of Manchester

‘Voices , visions and action of RRI’: institutional entrepreneurship and *de-facto* responsible research and innovation. Authors: Sally Randles, Elise Tancoigne, Kerstin Goos. University of Manchester, IFRIS, Fraunhofer ISI

Critical organisations: Multi-national Corporations (ag-bio; consumer). Author: Allison Loconto, IFRIS

3 Transversal lessons

We have identified a set of 13 ‘transversal lessons’ which are summarised here. The lessons are based on analysis of the 26 empirical case studies informed by the Res-AGorA research model and described above. The analysis has been summarised in two reports⁹. The final transversal lessons (Randles et al. 2015), are designed to facilitate a process through which RRI can become embedded within research and innovation processes at all levels. The case studies reflect an extensive range of responsible research and innovation governance situations and organisational contexts, incorporating different understandings of what constitutes responsibility.

The transversal lessons act as a series of check-points for organising and orienting actors towards responsible research and innovation that can be applied in a variety of situations. Our overarching lesson (Lesson 1) elaborates our main recommendation on *responsibilisation and deep*

⁹ Edler, J., Randles, S., Gee, S. (2014): Preliminary Lessons from the Case Study Programme (interim report, Deliverable D3.5), Manchester, available at: http://res-adora.eu/assets/ResAGORA-case-lessons-report-D-3_5-final.pdf; Randles, S., Gee, S., Edler, J. (2015) Governance and Institutionalisation of Responsible Research and Innovation in Europe: Transversal lessons from an extensive programme of case studies: Stakeholder Report; Manchester (Deliverable D3.6), available at: http://res-adora.eu/assets/Res-AgorA_321427_Del_3-6_final.pdf

institutionalisation and relates to changing the culture of organisations and individuals such that the principles of RRI become embedded in the research and innovation process. The next twelve lessons elaborate the elements which we consider necessary to bring about responsabilisation and deep institutionalisation of RRI and are organised into four clusters: participation and inclusion, knowledge and understanding, integrating across scales, and institutional change, respectively. The lessons are mutually reinforcing such that, together, they help to build the conditions to establish a culture of responsible research and innovation across a variety of governance scales and contexts. They provide a stepping-off point for the generation of broader principles to inform the RRI governance framework (the RRI Navigator) that forms one of the main outputs of the Res-AGorA project.

The Thirteen Transversal Lessons.

Overarching Lesson	
○,1	Responsibilisation and Deep Institutionalisation: this refers to a process of cultural change which internalises social values by embedding them into practices and processes. A holistic concept that brings the remaining twelve lessons together.
Participation and inclusion	
○,2	Transformative interaction: transformation is more likely to occur when the process is built on genuine engagement that is inclusive, open and transparent, fostering mutual trust and understanding from the initial framing of an issue onwards.
○,3	Intermediation and moderation: strong trusted neutral brokerage is required to enable diverse communities (in terms of location, perceptions, interests, capacity etc) to participate in a process that is perceived to be legitimate and credible.
Knowledge and understanding	
○,4	Anticipation: ethical codes that support a long term responsibility are based on consideration of alternative futures and can adapt to changing contexts to support a guardianship culture.
○,5	Knowledge: to be effective within responsibility discourses, evidence must be valid, adequate and trusted; hence it must be robust, transparent, inclusive, contextualised and sourced from a variety of stakeholders.
○,6	Timing: tensions across different temporal horizons must be managed recognising the dynamic nature of situations and contexts.
Integrating across scales	
○,7	Multi-level governance: this requires accounting for multiple levels of governance within and between organisations and political scales (e.g. regional, national, EU, global) and seeking synergies between top-down and bottom-up processes.
○,8	Alignment: aligning and synchronising the normative goals, objectives and procedures of instruments and measures across different levels to achieve consistency and clarity.
○,9	Boundary objects: shared objects (e.g. data) or processes (e.g. training) play an important role in translating between governance levels and supporting actors operating between boundaries in line with Lessons 7 and 8.
Institutional Change	

- | | |
|---------------------------|--|
| <input type="radio"/> ,10 | <i>Institutional Change:</i> creating a responsible research and innovation culture requires both institutionalisation (stabilisation) of new, and de-institutionalisation (modification) of current, behaviours, structures and procedures. |
| <input type="radio"/> ,11 | <i>Capabilities:</i> systematically developing skills and competences that enable actors at all levels to fully participate in responsible research and innovation transformation processes. |
| <input type="radio"/> ,12 | <i>Capacities:</i> the means and resources to create conditions for responsabilisation and to build a collective capacity for RRI at a societal level must be established. |
| <input type="radio"/> ,13 | <i>Institutional leadership and entrepreneurship:</i> from individual actors as leaders and 'change agents', to a broader culture of institutional entrepreneurialism, leadership is necessary to drive a range of normative societal, collective, responsibility objectives. |

4 Turning lessons into principles

The main purpose of the empirical work was to feed into the governance framework. In a series of iterations between the conceptual WP2 and the empirical WP3, the lessons learned in the case work were translated into the ten key governance principles. A few of our lessons informed the basic set up and framing of the framework, while most were translated directly into principles (see Table 5).

Table 5: Juxtaposition of lessons learned (WP3) and principles of the Responsibility Navigator

Case Lessons	Principles of the Responsibility Navigator
(1) Towards Responsibilisation and Deep Institutionalisation	<i>Note: this was a general observation in the case and is part of the preamble of the Navigator</i>
Governance processes	
(2) Transformative interaction needs to be inclusive open and transparent	(1) Inclusion
(3) Intermediation and moderation	(2) Moderation
(4) Anticipation: the importance of building future - oriented learning through a repertoire of anticipatory techniques and methods	Anticipation is the underlying rationale of the Navigator across the principles
(5) Robust, inclusive, and contextualised knowledge	(3) Deliberation
(6) Timing: the importance of time, timing and managing tensions of different temporal horizons.	(6) Adaptability (over time)
(7) Multi -level governance: the importance of taking account of multiple levels of governance and seeking synergies between top-down a. bottom-up processes	(5) Subsidiarity
(8) Alignment: the importance of aligning and synchronising the normative goals, objectives and procedures of different instruments and measures.	(4) Modularity and flexibility
(9) Boundary objects: the effectiveness of instruments as boundary objects and of actors as boundary-crossing agents.	<i>Note: this is a lesson learned about the mechanism of transformation, process, but is not to be translated into a principle</i>
Actors, Agency and Institutionalisation processes.	
(10) Institutional Change: simultaneous institutionalisation and de-institutionalisation processes, organisational re-design and the creation of an rri/RRI ¹⁰ culture.	<i>See note above, it is a reminder, from the case analysis, that governance of rri is always an interplay of institutionalising new principles and routines on the one hand and de-institutionalising others.</i>
(11) Capabilities: the systematic building of capabilities at the level of individuals, groups, and organisations enabling them to fully participate in rri/RRI transformation processes.	(7) Capabilities
(12) Capacities: the systematic and systemic building of resources at a societal level to enable rri/RRI to become part of a broader cultural shift	(8) Capacities
(13) Institutional leadership and entrepreneurship	(9) Institutional entrepreneurship
<i>Note: the idea that certain basic societal and political framework conditions need to be in place in order to make the governance framework work is a strong reminder that rri does not develop in its own space, but in broader framework, and the governance principles cannot unfold if those basic conditions are not met.</i>	(10) Culture of transparency, tolerance and rule of law

¹⁰ As stated above, rri refers to de facto responsible research and innovation, where actors' own or historical understandings of responsibility are already embedded into research and innovation practices and governance processes as an emergent property of RRI in-the-making, while RRI means the existence of a formal, codified framework of responsible research and innovation.

We need to stress that the translation of the case lessons into principles was a collective exercise between members of the Res-AGorA team (WP 2, 3, 4) but also was strongly supported by interaction with stakeholders in our five workshops.

The case studies, finally, also served to inform illustrations of the principles in the Responsibility Navigator. For all but the general principle of transparency and rule of law (principle 10) we formulated **vignettes**, which are **fictive** and drafted as illustrative **ideal cases**. However, each vignette is inspired by our case-study findings as well as the reactions and interpretations of stakeholders in our deliberations. In the remainder of this section, we depict those nine vignettes, which have been embedded into the Responsibility Navigator.

Vignettes to illustrate the Res-AGorA principles

Vignette for principle 1: Inclusion.

Developing a roadmap for an emerging technology based on a broadly accepted process

The research councils of a midsize European country are exploring the future potential of an emerging technology, synthetic biology (synbio). The pressure from a number of Government Departments (a coalition of Economics, Business and Technology/Innovation) is to focus funding on advancing technological development as an expected route to accelerating economic and technological growth, but their proposed process is a hurried one and does not allow time to organise a dialogue involving broader participation of societal actors and stakeholders. However, the research councils responsible for biology and chemistry, supported by funding available from the supra-national governmental body, organise a national discourse on the future of synthetic biology and its contribution to a range of societal objectives, across health, well-being, environment, sustainability, and economic growth. Inclusion is managed by a combination of online consultations (*principle 1: broad openness, bottom up*) and physical meetings (*principle 1: targeted inclusion, sufficient level of representation*). They ensure that the invitation list for the physical meetings is coordinated with the ministry of science and education, the ministry for economics and the research council responsible for social sciences, to include a broad variety of stakeholders (*principle 1: heterogeneity of actors to be included, broad ownership of debate*). Invitees include firms and research organisations seeking early commercialisation; actors and organisations that have been openly sceptical about an accelerated development of applied synbio research as well as observers from social science (including philosophy and ethics). Care is taken to ensure diversity of opinion is represented from the outset, including how the topic is framed (*principle 1: initial openness of the framing of an issue*). The roadmap is drafted in an iterative and dynamic process by a group of authors reflecting diverse perspectives. Minority views are clearly expressed in the final roadmap and its operationalization provides for resources to enable on-going adaptive and inclusive dialogue and action including the full range of stakeholders (*principle 1: demonstrating inclusion, accepting dissent*).

Vignette for principle 2 Moderation

Moderated discourse to rebalance national research funding profile

As a matter of high political priority, the government of a small European country is reconsidering the balance of research funding between calls for research activities directed through thematic programmes/grand challenges and those without thematic prioritisation. The Science and Technology Advisory Council (STAC) is tasked with implementing a forward looking process to realise this. STAC is composed of representatives of all major political parties, employer's and employees' organisations, civil society organisations and consumer groups and scientists representing different disciplines (including social scientists), aiming for balanced representation of organisation type, level of seniority and gender (*principle 2: initial moderation through neutral actors without operational budgets and a representation of major vested interest*). A Task Force (TF) is established, representing a wide diversity of societal groups and perspectives, giving each member time to design and implement a systematic and open process of evidence gathering (background reports, international hearings etc.). The TF appoints an independent figure to draft a report which outlines different models of, and the pros and cons for, thematic prioritising in research funding, based on evidence from a number of comparator innovation systems. The process separates the decision about the share of thematic prioritising in research funding from the choice of themes (*principle 2: building trust in the process as the basic decision is taken without focusing on specific areas, providing robust data*). In response to the report, STAC asks for Parliament (through two committee meetings with open inclusive hearings) for an online consultation, the results of which are detailed in an Annex to the TF report (*principle 2: moderation iterates between advisory context and political context, combining different sources of legitimacy*). On STAC's recommendation, core funding is reduced and funding in competitive and thematically defined areas is increased, followed up by a well-received, challenge oriented foresight process to support a further transparent dialogue to frame, define and prioritise the definition of 'challenge' areas, based on a similar model of neutral moderation.

Vignette for principle 3: Deliberation

Organising a co-constructive deliberation process on responsible innovation.

A research team from nine universities and research institutes wins a competitive European research grant to develop a framework for fostering responsible research and innovation. A co-construction deliberative methodology is adopted, involving representatives of relevant functions and organisations (academics, research funding councils, research performing organisations, small business and multi-national corporations, utilities, local and national governments, civil society organisations, and known individuals with a commitment and expertise in Science and Society dialogues) (*principle 2: sense-making and decision making among actors with different knowledge claims and positions*). The methodology comprises five two-day stakeholder workshops held in different European cities and with approximately 80 participants in total. The workshops are themed to test the prototype framework across different contexts. The first two focus on technology controversies – energy, climate change and shale gas fracking; and genetic modification of food. The third and fourth look at problems of responsibility in research and innovation from the perspective of research-funding and research-providing organisations respectively; the final workshop comprises

participants with a spread of backgrounds and functions, with a focus on strategic actors. The workshops use techniques to maximise opportunities for participants to actively engage in the process (*principle 3: opening up for mutual understanding*); although team members are present at the workshops, they influence the deliberation as little as possible, with the primary aim of listening to discussions in order to understand the real-life working contexts of participants and their perceptions of the prototype framework. The deliberation process is supported by a fully transparent empirical knowledge base, generated by the research team over two years. The process of co-constructive deliberation is realised through a comprehensive multi-disciplinary and multiple-stakeholder process of critical reflection. The result is a stabilized framework of 10 key governance principles, communicated in a style sensitised to practitioner audiences (*principle 3: discussions lead to some level of consensus*). The principles are supported by fictive case vignettes built from the empirical programme of the team's research. The final framework becomes a tool to support self-reflection and strategic action of practitioners – user-friendly and integrating the recommendation of participants.

Vignette for principle 4: Modularity and flexibility.

A flexible code of conduct for responsibility across institutions and research practices

A large semi-public public lab in the area of nano-toxicology is committed to the highest ethical standards and the accommodation of societal concerns and needs, with recruitment procedures and training aimed at establishing and promoting a diverse work force. The institute has put in place a number of internal principles and processes to achieve this mission which are reviewed periodically (*principle 4, modularity*). One core instrument is a professional code of conduct of engineers and scientists in the field of nanosciences and technologies (*principle 4: flexibility*); its contents are integrated into internal institute guidelines and employment contracts, and promoted throughout the organisation from recruitment up to all major activities (*principle 4: communication, mechanisms to be easy to understand*). Further, the institute conducts periodic internal and external seminars and meetings to deliberate and anticipate the ethical, health, natural environment, regulatory and socio-economic implications of the laboratory's research lines and how their research relates to societal challenges. In addition to these soft instruments, there is a formal sign off process of all research activities (including, but not limited to, external research proposals) which again links to the code and the internal guidelines (*principle 4: combining 'hard' and 'soft' regulatory mechanisms*). Working with the code gives staff a "responsibility literacy" and creates awareness internally (*see also principle 7, capabilities*); it also positions the institute as a credible actor within the broader professional and societal discourse on responsibility, able to influence debates both specifically and towards a more systemic adoption and commitment by organisations in general (*see also principle 5 subsidiarity, influencing and taking advantage of higher levels of governance*).

Vignette for principle 5: Subsidiarity.

A dialogue between European supra-national and global governance organisations on responsibility in research and innovation.

A supra-national European organisation has spent years developing an understanding of RRI and mainstreaming it within its own science and innovation programmes. It approaches a global governance body, initiating a conversation on how to standardise and up-scale this concept to the global level, upholding three core tenets of RRI: participative governance, orientation to societal challenges, and futures-oriented anticipation of technological development and global political economy. This is welcomed, but in order to canvass a wider range of perspectives, the global organisation initiates a consultation, seeking evidence from other countries around the world, supra-national regional governance bodies, multi-national companies, and civil-society organisations (CSOs) with cross-border and North-South remits. Evidence shows that RRI, as interpreted by the European supra-national body, has in fact originated from quite a concentrated cluster of nations and from its own ‘science in society’ legacy programmes. The leadership of these nations is acknowledged but, beyond this limited cluster, other countries have a much lower awareness, still less experience, of implementing RRI. These other countries vary considerably in economic, political, social and cultural terms, putting them at disadvantage should the supra-national body seek to impose a common understanding of RRI. Multi-nationals and global CSOs give a mixed response. The standardisation of concepts is welcomed by some but is resisted by others as a new form of imposition by strong nations. Rather than simple up-scaling a particular interpretation of RRI, the global organisation proposes a 3-year initiative where countries and regions from across the globe (supra- and sub-national) exchange perspectives and knowledge on what it means to undertake research and innovation in a responsible way (*principle 3: balancing bottom-up and top-down RRI governance approaches*). This knowledge will be shared through the intermediation of the global body, enabling nations and CSOs and business fora to learn from, adapt and translate the concept within their own contexts (*principle 3: self-governance and self-control overseen by independent actors*), whilst acknowledging the three core tenets of RRI.

Vignette for principle 6: Adaptability.

Institutionalising ethical business practice in a highly contested technological area

A medium sized, strongly growing firm is a leader in research on the digital genome and its application to medical innovation. With the advent of rapid sequencing and digital synthesis of DNA/genomes, the firm capitalises on the many commercial opportunities in the fast growing area of personalised health. Fully aware of the threats posed by the “transparent individual”, including pressure from employers and insurers to disclose personal health information, the firm has put in place various RRI governance mechanisms. Its own ethics committee meets quarterly to advise researchers and product and marketing managers on the ethical and societal implications of new products and processes. The ethics committee is composed of representatives of different research and business areas within the organisation (senior and junior individuals) and external stakeholders and experts, including social scientists (*principle 1: targeted inclusion, sufficient level of representation*). Recommendations by the committee require a formal response by the responsible

researcher, product manager and the firm's leadership before implementation throughout the organisation. A 'roving' social scientist is embedded within the company to advise on socio-technical integration, building reflexive capabilities to critically question the status quo, facilitating bottom-up participation, guided by top-down protocols. This approach supports the development and adaptive translation of responsible innovation principles into practice right across the business. In addition, an external advisory board representing divergent views meets every two years, reflecting on the development of the field, its application context and the broader societal and political developments as novel business models associated with the digital genome emerge (*principle 6, adaptability, in-built mechanisms to reflect on the appropriateness of the existing internal governance mechanism*). The board also reviews the work of the ethics committee and its guiding mission, principles, and operationalization, proposing new or revised working practices. Moreover, it reviews how the organisation can institutionalise responsibility to increase employees' awareness of societal concerns (*principle 7: capability building; principle 8: capacity*). The firm's CEO participates, encouraging employees to participate in shaping the broader societal multi-actor discourse on genomics and personalised health applications. The firm receives an award for its effective implementation and leadership in Responsible Research and Innovation; its share price, turnover and profits continue to grow.

Vignette for principle 7: Capabilities.

Creating conditions and processes to build up a new generation of RRI conscious researchers

A research funding organisation seeks to enable greater reflexivity and anticipatory awareness of issues of societal concern in the community it funds. It has long adopted a formal framework that guides its programme design as well as its funding application and approval processes. Relying on formal principles in project proposals has resulted in RRI becoming yet another tick box exercise. The organisation thus starts to focus on building capabilities and awareness of its researchers, starting with the young generation of researchers and their employing organisations. Now, all funding applications have to show how they propose to accommodate specific challenges such as risks, ethical concerns, further societal challenges (by incorporating participation/engagement, for example). All proposals are required to allocate part of the budget and research time to issues of interaction and awareness building beyond traditional "impact" considerations. In addition, to be eligible, proposals must demonstrate how the supporting organization will enable researchers to identify, plan and achieve an action plan to deliver an RRI portfolio (*see principles 8, capacity; and 5, modularity, soft and hard instruments*). Importantly, the funding organisation also conducts a series of three day workshops for young leaders of funded projects across the country; Principal Investigators (responsible for line-managing the early career researcher) are expected to participate in such a workshop early in the project. This not only involves teaching general principles and guidelines but a collective critical reflection on responsibility challenges and ways to deal with them. Each PI is required to draft a responsibility report 2 months after the workshop, signed off by their own line manager, committing the host organisation to supporting the early career researchers, recognizing the additional work and resources necessary to implement personalized RRI plans. The early career researchers receive progressive certificates of competency in RRI, building credits towards a new vocational qualification in Responsible Innovation, which is becoming increasingly

recognized by employers. As a result, the system builds a more reflexively aware, questioning, and therefore bench-effective, RRI literate workforce.

Vignette for principle 8: Capacities.

A Civic Society Organisation lobbies for institutional change and system capacity-building.

A large Civic Society Organisation (CSO) is aware that efforts are being made to improve the capabilities and sensitisation of researchers towards responsible innovation criteria via training for individuals, especially early career researchers (in participative and co-construction methods, the development of researchers own reflexivity and sensitisation to societal problems, risks and impact, inter-disciplinary working and futures oriented methods). Research Councils have begun to write these training requirements and institutional responses into new research calls (principle 7, Capabilities). However, the CSO believes that there is a need to go further to achieve systemic institutional change in order to redress the current dominance of scientific, business and government elites. It acknowledges that current institutional dis-incentives such as long lead times to publication and publication league tables, alongside competitive pressures within the new product development pipeline of large businesses, mitigate against the aspirations of responsible innovation. The organisation argues for a more fundamental role for civil society in constructing research and innovation pathways, with earlier participation in technology assessment dialogues and involving values-centred small and medium and social enterprises. The CSO leads the creation of a network of CSOs covering a range of interests and remits from health and well-being to the natural environment and human rights (*principle 8: a supportive organisational and network infrastructure*). The network seeks to develop capacity internally and beyond, seeking external funds from government and other sources (*principle 8: available spaces for reflection, interaction and negotiation and an open knowledge base*). It lobbies for deeper institutional change within the dominant institutions of research and innovation to achieve greater diversity of workforce, early and transparent dissemination of results, and the engagement of wider constituencies of users and stakeholders of research and innovation. However, in order to effectively engage and influence systemic change, the network needs to build the capacity of its network members as well, in order to be able to provide a voice that can balance that of the other stakeholders within the emerging dialogue on what constitutes responsibility in research and innovation.

Vignette for principle 9:

Institutional entrepreneurship. Organisational transformation within a large American university.

A decade ago, a new President was appointed at the Abernath University, USA, a very large public university. President Stark had a strong vision of a 'Good University', critical of the institutionalized model of top-league American universities: exclusive and narrow in faculty and student base; working in discipline silos; and unconcerned about social problems in regional environments. His vision of 'responsibility' was to demonstrate how a public university could perform successfully in financial terms, yet be founded on the inverse normative criteria: an inclusive student base; excellent science; and inter-disciplinary approaches addressing social problems (*principle 9:*

leadership, vision and strategy). Many senior faculty embraced this vision and joined the management team, whilst others were recruited who shared it. A new organizational structure was developed along inter-disciplinary lines of problem-facing centres and institutes. Faculty took on multiple identities: according to their problem-focused centre; according to their teaching host school; and according to their 'normative home', eg Sustainability. Networking across these identities was facilitated through meetings and events, and new inter-disciplinary centres established (with five-year reviews) (*principle 9: capability and capacity building are not one-off activities*). Middle tiers of Principal Investigators and faculty were recruited who shared the broad vision, translated to their field, and who were entrepreneurial, forming inter-disciplinary teams to bring in new grants. There were turbulent years of disruption and change and some who were not comfortable with the new model left the university. Finally, the grant income of the university has increased four-fold and the student body has increased dramatically, now reflecting the ethnic demographic of the State and with a focus on students whose parents did not attend university. The model has been communicated through books co-authored by Stark, many You-Tube videos and Stark's talks around the world. He entreats others not to replicate the model but to adapt it to prevailing local social contexts and changing global problems.

5 Conclusions and lessons from lesson drawing

In this report we have summarized the empirical programme in Work Package 3 and the major lessons we have drawn from it. The main high level conclusions can be summarized as follows

1) The conceptual and empirical work has confirmed our starting assumption that **governance challenges** as regards responsibility of research and innovation are highly **context dependent**. In Res-AGorA we have elaborated a short list of **dimensions** to characterize situations in which responsible research and innovation is aspired to (section 2 of this report).

2) We have seen that these dimensions characterize three different types of governance situations and challenges:

- **normative** orientation of actors involved (e.g. level of contestation),
- existing **governance instruments and mechanisms** (what instruments are in place that influence and orientate research and innovation in a given situation) and
- **substantive** dimensions (e.g. level of uncertainty, closeness to market etc.)

These three bundles of dimensions served to capture the variety of the different governance challenges and enabled us to think systematically about them. This conceptual step in itself is an important contribution of Res-AGorA as it further simplifies the analysis and **allows stakeholders** using the Responsibility Navigator to **understand** their own situation and **governance challenges**.

3) The conceptual work to characterize governance challenges combined with the empirical work in our case studies made us realize that the **techno-scientific dimension** is **not a major determinant of governance challenges and processes**. Rather, the situations dimensions we have elaborated can differ within the **techno-scientific** domain, or be similar between two domains. Thus, the lessons hold across the domains, while other variables have proved to be more important. This finding led us to reject our starting assumption about the importance of **techno-scientific** domains.

4) The main contribution of the empirical work programme in this work package has been to identify **13 transversal RRI governance lessons** out of the case analysis. Those lessons were derived from a broad variety of cases, and while all cases have their own RRI governance challenges, the lessons are **relevant across this variety of situations**. Further, we have seen that there are two categories of lessons, one that is related to **governance instruments and processes**, and one that relates to the **importance of capabilities, capacities and institutional conditions**.

5) **The overarching lesson out of the 13 lessons** has been that transformation towards responsible research and innovation is only possible through processes of **responsibilisation** and **deep institutionalization**, understood as plurality of societal values embedded into normative goals, translated into regulatory and governance processes, procedures, instruments, and organisational structures and incentives, and ultimately into taken - for - granted practices, routines within institutions. We have juxtaposed this necessary requirement for transformation with the phenomenon of **responsibility wash**, i.e. a cynical or superficial adoption of responsibility principles or instruments.

6) Finally, the case work has also allowed us to create **vignettes**, i.e. fictive cases as **illustrations** for the principles of the **Responsibility Navigator**. The use of the vignettes has enabled the team to highlight the key features exemplified in the case studies that are compatible with principles of RRI; this has been used both as a means of illustrating the principles and how they might be applied and interpreted in real world situations but also to condense key aspects from the various case studies. They are thus a vehicle for both communicating results from a lengthy body of empirical research while at the same time animating the Responsibility Navigator principles. This is an essential contribution to the usability and user-friendliness of the Navigator, as it makes the abstract principles very concrete, and in doing so supports stakeholders in search for guidance towards responsabilisation and deep institutionalization of responsible research and innovation.

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