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Deliverable D2.1: Modular Scenario Report – Synthesis

New ways of doing research: from explorative to transformative scenarios

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Project consortium

Participant no.	Participant Organisation name	Participant short name	Country
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Content

Executive Summary

There is growing evidence that new research practices and the changing conditions under which scientific research is undertaken are reconfiguring the landscape of research and innovation. The project **"Research and Innovation Futures 2030: From explorative to transformative scenarios" (RIF)** focuses on analysing new and emerging ways of doing and organising research with the purpose to help prepare for the challenges and opportunities that may arise on tomorrow's research and innovation agendas.

Scenarios developed in the RIF project are formulated in two stages, including an explorative stage and a transformative stage. The **explorative scenario stage** is based on the assumption that ongoing developments will give rise to tensions and dilemmas in research and innovation if current institutional settings are still in place in the mid-term.

The explorative scenario stage examines five key tensions and dilemmas around 2020:

1. The coordination of research and innovation is complicated by the increasing fragmentation of the research and innovation landscape and by conflicting actor strategies.
2. A worldwide struggle breaks out between scientific expert knowledge and other forms of knowledge, such as traditional or lay knowledge, competing for credibility, legitimacy, and funding.
3. Societal unease grows about the failure of conventional research and innovation programs to address pressing societal challenges effectively.
4. Economic pressure on research-performing organisations intensifies due to requirements for fund raising and evaluation as well as stiff competition for limited research funds.
5. The attractiveness of usual academic careers declines because of conflicting demands on individual researchers from different directions eventually leading to identity crisis.

These tensions and dilemmas may be tackled within the confines of current institutional settings, or may bring about a substantial transformation of our research and innovation landscape in the long-term, which is captured at the **transformative scenario stage**.

Five distinctive development paths lead from the five tensions and dilemmas around 2020 to transformations of the research landscapes in 2030:

Scenario 1 *Open Research Platforms*: The research landscape in a decentralized, global and open world is characterised by Open Research Platforms (ORPs) fully open to wider society. ORPs interconnect research-performing organisations (and individual researchers) and funding mechanisms supported by Web 3.0 technology. ORPs are self-governed: they set their own research agendas supported by data-mining and semantic analyses, organise research done with next generation collaboration tools, and facilitate research quality assessments through its contributors. Into the vast knowledge flows passing though these ORPs, governments worldwide embed their soft coordination activities and provide incentives to research groups to contribute to certain ORPs of public interest.

Scenario 2 *Knowledge Parliaments*: All kinds of knowledge claims are raised and negotiated worldwide in the so-called 'Knowledge Parliaments'. Knowledge parliaments prioritize research

topics and provide 'trading zones' in which actors with particular research interests, topics and epistemologies collaborate and compete for support. Not only the building of research consortia that incorporate citizens, a variety of other stakeholders and epistemic cultures (e.g. lay and indigenous knowledge), but also the research processes and conceptions of research quality are freely negotiated by the power of the argument. Thereby, neglected or under-represented research topics and unconventional knowledge domains are brought to the fore.

Scenario 3 *Grand Challenges for Real*: Considerable proportion of research is oriented towards dealing with Grand Challenges at the global level. In Europe, research on Grand Challenges is organised in large Knowledge and Innovation Communities (GC-KICs) equipped with large funds and clear mandates. Each GC-KIC oversees several socio-technical laboratories in which a number of different solutions responding to Grand Challenges are developed and tested. Diverse actors such as citizens, companies, universities, and social entrepreneurs engage in collective experiments. Experimentation, measurement of practices and impacts, and co-creation go hand in hand so that real progress towards tackling Grand Challenges – as promised by EU policies – can be demonstrated.

Scenario 4 *Knowledge Value Chains*: The main purpose of research all over the world is to foster innovation for economic competitiveness. Thereby, public and private research is thoroughly intertwined. Research is carried out in 'Knowledge Value Chains' (KVCs) organising the cooperation between three types of highly-specialized and stratified organizations according to business management principles: Research Integrating Organisations, Research Service Organisations, and Third-tier organisations providing fragmented research contributions. The companies involved in the KVCs influence ownership and exploitation of research decisively. There is polarization and dependence among regions and key actors worldwide and in Europe to cover certain research fields.

Scenario 5 *Researchers' Choice*: Societies worldwide shift their measures of progress towards individual and societal wellbeing. Research is value-driven and oriented towards the new measures of progress. Autonomous researchers follow more individualistic development paths outside established research-performing organisations. Their career choices cover a broad spectrum of models, ranging from new forms of science entrepreneurship to more collective forms under the umbrella of "slow science" with a strong orientation towards local societal needs. Globally, the development of framework conditions suited to leverage the potential of autonomous researchers for societal wellbeing remains a constant challenge for policy formulation and coordination.

The five scenarios developed for RIF 2030 provide comprehensive images of how the world of research and innovation may look like in 2030, how it is embedded in society, and how plausible pathways of evolution towards the transformation of our research and innovation landscape may look like. These scenarios are devices to explore a broader perspective on the future than just analysing emerging trends and thus stimulate our thinking about the research and innovation futures we want to pursue or avoid. At the same time, we should acknowledge that they may all happen and co-exist to a certain extent. Preparatory (and also preventative) actions may need to be taken from today. Research and innovation policies can be developed for example to (1) design embedded governance models for the open collaborative research landscape, (2) install new fora for the negotiation of knowledge claims, (3) systematically analyse and assess the potentials of specifically-designed structures for dealing with Grand Challenges by collective experimentation, (4) survey concentration and diversity of competences of research-performing organisations over time, and (5)

consider autonomous researcher careers as a serious option in the near future. Apart from the specific developments encapsulated in the scenarios, they all point to a further **recontextualisation of science in society**. Research and innovation policy must direct research and innovation in the face of blurring boundaries, increasing variety and expansion of the research and innovation system.

1 Introduction

There is growing evidence that new research practices and the changing conditions under which scientific research is undertaken are reconfiguring the landscape of research and innovation (R&I) (see: RIF Stocktaking Report 2012). A number of high-level reports analyse emerging trends and issues in R&I broadly,[1] whereas foresight studies systematically exploring alternative futures of R&I are rare.[2] However, systematic foresight is an important means to recognize the nature, dynamics and societal implications of the reconfiguring R&I landscape adequately for European R&I policy-making.

The RIF project

The RIF 2030 project "Research and Innovation Futures 2030: from Explorative to Transformative Scenarios" explores new and emerging **"future ways of doing and organizing research"** in universities, research organisations, companies and civil society. It aims to:

- systematize knowledge on emerging patterns, trends and drivers of change in ways of doing and organising research in our knowledge societies,
- provide an outlook on R&I by way of
  (1) medium-term explorative scenarios exploring key developments and tensions by 2020,
  (2) long-term transformative scenarios of alternative developments by 2030,
- identify and assess key issues against the background of the European Research Area (ERA),
- establish a dialogue on strategic options for different stakeholders.

RIF concentrates on the dynamics of change resulting from the interplay of developments within the R&I systems and in their societal context. It is based on the assumption that current developments are likely to give rise to tensions and dilemmas in the medium-term that need to be addressed if R&I are to play a key role for society. These tensions and dilemmas may be tackled within the confines of current institutional settings, or they may bring about a substantial transformation of our R&I systems as well as of our R&I practices in the long-term.

The RIF project provides a comprehensive and systemic view on emerging and possible future developments in doing and organizing research. It goes beyond extrapolation of current developments and explores new perspectives qualitatively. It thereby sketches ways on how to deal with emerging tensions and dilemmas at the interface between explorative and transformative scenarios. Possible implications for different actor groups and stakeholders are anticipated.

The RIF scenarios

The scenario development in the RIF project (Work Package 2) aims to provide an outlook on R&I futures relevant for R&I policy-making in particular at — but not restricted to — the EU-level.[3] The RIF scenarios contain sequences of future situations that advance with different thematic and geographical boundaries. The RIF scenarios do not mean to describe the entire world of R&I. Each scenario reflects a significant part of the future world of R&I, while conventional or alternative ways of R&I may go on in other parts.

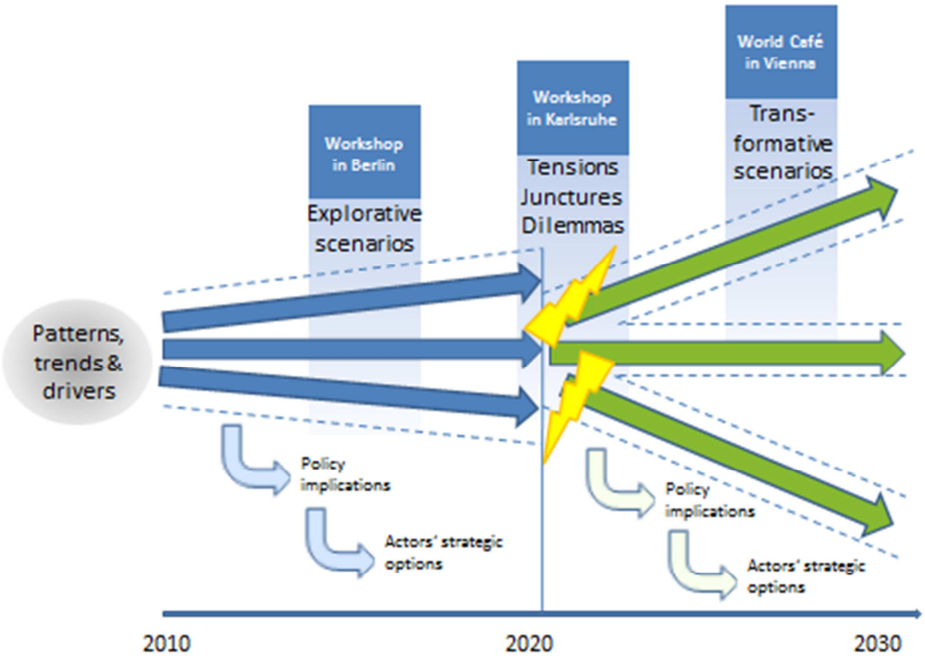
1 c.f. for example MASIS (2009), OECD (2012), The Royal Society (2011), UNESCO (2010)
2 c.f. for example Fraunhofer (2010), ICSU (2011), INFU (2012)
3 c.f. for example the concept of multi-level governance developed by Kuhlmann (2001).

Furthermore, the RIF scenarios do not claim "to predict the future", neither are they about assigning probabilities of occurrence. Instead, they are about exploring transformative, yet plausible futures. They aim at stimulating reflection and learning by raising novel aspects and at the same time stay within the sphere of belief (Loveridge 2009).[4] They have the ambition to raise awareness of potentially radical future changes, and thus help policy makers, research funders, public and private research performers and civil society to prepare for challenges and opportunities beyond the currently dominating debates.

The RIF scenarios explore future patterns, trends and drivers of doing and organizing research based on the preceding RIF Stocktaking work (Work Package 1). As "ours is a time of three-level change" (Nelson 2010, p. 292),[5] R&I practices, the organization of R&I and science in a changing society are considered in the RIF scenarios. All three levels of change thoroughly interpenetrate each other. The RIF scenarios are nested in a broader context by considering relevant global long-term developments captured by the STEEPV themes[6] and Europe's position in a changing world (c.f. Loveridge 1998).

The scenarios on R&I futures are built around two time horizons. Each scenario is composed of an explorative stage by roughly 2020 and of a transformative stage by roughly 2030 (see Figure 1.1).

Figure 1.1: Schematic diagram for the scenario development in the RIF Project (Source: RIF)



The **explorative scenario stage** of the RIF scenarios is based on the assumption that current patterns, trends and drivers of change continue until 2020 and beyond whereas the prevailing institutional settings for R&I will by and large remain in place. This scenario stage serves to explore emerging

4 People involved in the scenario process had different views on what is novel and what is beyond belief. The RIF scenarios thus represent the views of the RIF consortium.

5 First level: doing physical things (e.g. sample water), second level: thinking about doing physical things in any organized area of life (e.g. develop a water sampling program), and third level: "sensing" and grasping the changing historic context in which one lives (e.g., shift in perceptions of water relevance).

6 STEEPV is the acronym for Social change, Technological change, Economic change, Environmental change, Political change and (personal) Value change.

tensions and dilemmas in the current R&I system. Tensions and dilemmas are supposed to emerge in the R&I system because the strategic fit of the R&I system to the changing world tends to decrease over time (c.f. Curry / Hodgson 2008) due to the inertia of institutional settings. Tensions and dilemmas may raise negative connotations in the first instance. However, they should not be avoided in any case, because they may already embody the impetus for transformative change (e.g. system innovations) that should be leveraged actively in order to better prepare for the future.

The **transformative scenario stage** of the RIF scenarios is based on the assumption that ever more aggravating tensions and dilemmas may not be able to be contained within the current institutional settings for R&I. These transformations can be induced by an opening up of the current institutional settings and by divergent behavior of certain actors (Boudon 1986, de Poel 1998, Rip 2011). The transformative scenario stage aims to trace the junctures and mechanisms about how the current institutional settings might be transformed into new institutional settings for R&I by 2030.

The RIF **scenario development process** included three interactive workshops: the first workshop (Berlin, 14-15 June 2012) served to assist the explorative scenario building, the second (Karlsruhe, 18 September 2012) to draft the transformative scenarios, and the third (Vienna, 22 October 2012) to discuss and flesh out the complete scenario storylines. Workshop participants covered all actor domains and were assumed to be considerably involved in and/or affected by the anticipated changes (academia, policy, civil society, publishing, industry, etc.).

The entire RIF scenario development process, the underlying methodology, and its linkages to other RIF documents and external sources, is described in detail in Annex A. Table 1.1 lists the main sources and their use in the scenario development process.

Table 1.1: Main sources used to construct the RIF scenarios

Source	Main use	Annex
RIF Workshop "Explorative Scenarios". 2012.	R&I scenarios	B
RIF Workshop "Transformative Scenarios". 2012.	R&I scenarios	C
RIF World Café. 2012.	R&I scenarios	D
RIF Stocktaking Report. 2012.	R&I scenarios	E
RIF Stakeholder Report. 2012.	R&I scenarios	F
US Government 2008: Global Trends 2025.	Global dimension	G
UK Government 2010: Global Strategic Trends – Out to 2040.	Global dimension	G
EUISS 2012: Global Trends 2030.	Global dimension	G
EC 2012: Global Europe 2050.	European dimension	H
ESPON 2007: Scenarios on the territorial future of Europe.	European dimension	H
EU Reflection Group 2010: Project Europe 2030.	European dimension	H

The annexes include a brief description of the respective sources. While R&I futures were elaborated within the RIF project (input papers and workshop documentations), the scenario nesting made extensive use of publicly available documents.

In Work Package 3 (Scenario Implication Assessment) the implications of the scenarios are analyzed under three main perspectives, that of R&I and education policy, developing ERA, and addressing Grand Challenges. Critical strategic issues are identified for further discussion with key stakeholders in Work Package 4 in an attempt to define certain strategic options for action for the different types of stakehodlers involved (RIF Stakeholder Report 2012).

The modular scenario report

The modular scenario report comprises three documentation formats:

- **This Synthesis Report** condenses the essence of the RIF scenarios. At its core, it provides an overview of the five scenarios, which are then presented one after another, and compared.
- A separate Annex Report delivers all the background information on the methodology and sources used to develop the scenarios (Annexes A-H).
- A slide show and a poster are designed to enable quick and effective communication at conferences and workshops.

Chapter 2 of this Synthesis Report presents the five RIF scenarios including:

1. Open Research Platforms – Self-governance in a decentralized research landscape
2. Knowledge Parliaments – The free negotiation of knowledge claims
3. Grand Challenges for Real – Collective experimentation in socio-technical labs
4. Knowledge Value Chains – Research for innovation in a specialized and stratified research landscape
5. Researchers' choice - Autonomous researchers go for self-fulfillment and wellbeing

Chapter 3 compares the five RIF scenarios. None of the scenarios is exhaustive, as stated above, but each scenario is complete in addressing all relevant aspects of what constitutes "future ways of doing and organizing research":

- What are the critical tensions or dilemmas around 2020?
- What are the key mechanisms for inducing transformative change between 2020 and 2030?
- How would transformed research landscapes appear in 2030?
  - How are research agendas defined, and how is research funded?
  - How is the output produced, and how is quality defined and assured?
  - Who owns research results and can exploit them?
  - How is research organized, and what are the main types of organisations?
  - How does research work look like in practice?

Chapter 4 contextualizes the findings and derives some key lessons learnt thus far.

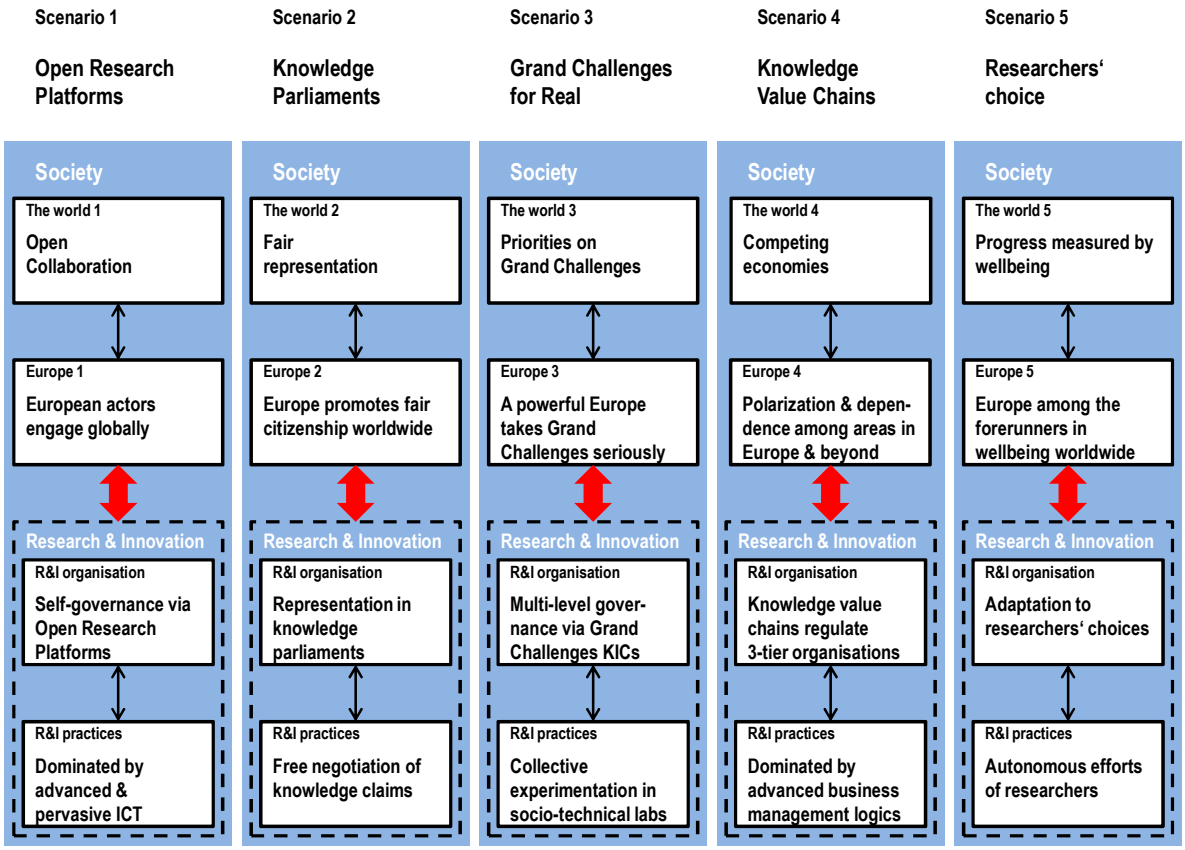
Further information can be retrieved from the website and workspace www.rif2030.eu.

2 The scenarios for Research and Innovation Futures

This section presents five scenarios for Research and Innovation Futures. First, an overview is given; second, the five scenarios are displayed one after another.

The RIF scenarios describe different R&I futures nested in different futures of Europe and the world by 2030. The tensions and dilemmas of 2020 are overcome at large by the transformation of the R&I system into a new configuration in 2030. However, the transformed R&I organization and practices face new tensions and dilemmas in 2030. Figure 2.1 shows the composition of societal futures and R&I futures for each of the five scenarios.

Figure 2.1: The set of five nested scenarios for Research and Innovation futures 2030 (Source: RIF)



Note: ICT – Information and Communication Technology, KIC – Knowledge and Innovation Community, R&I – Research and Innovation

The *Open Research Platforms* scenario nests R&I in an open and collaborative world. It is assumed that European actors strongly engage in these open and global collaborations. The EU sees its role however as a facilitator, rather than driver, of networked activities of its citizens, industry and governments both in Europe and globally by 2030. Advanced and pervasive ICT supports open networked research in a dispersed and decentralized R&I landscape. The Open Research Platforms emerge as means of R&I self-governance.

The *Knowledge Parliaments* scenario nests R&I in a world in which fair representation of citizen stakes is a universal value in most societies. It is assumed that European countries promote fair citizenship internally and worldwide by 2030. A predominant element of the new R&I practices is the free negotiation of knowledge claims allowing all kinds of epistemic cultures to be represented in R&I. These diverse knowledge claims are negotiated in the so called “knowledge parliaments”.

The *Grand Challenges for Real* scenario nests R&I in a world broadly acknowledging Grand Challenges as a key issue for R&I. The EU is able to choose a separate path because it disposes of powerful multi-level governance mechanisms and a civil society which asks to take Grand Challenges for real. Collective experimentation in socio-technical laboratories is the main R&I practice driving evidence-based progress towards tackling Grand Challenges. R&I are organized in Grand Challenge Knowledge and Innovation Communities.

The *Knowledge Value Chains* scenario nests R&I in a world of stiffly competing economies in 2030. Europe is no exception in this regard. Like the rest of the world Europe is characterized by polarization and dependence among geographic areas and key actors to cover certain research fields. R&I practices are dominated by advanced business management logics. R&I are organized in knowledge value chains regulating the interaction of specialized and stratified research-performing organisations.

The *Researchers' Choice* scenario nests R&I in a world oriented at wellbeing as the principle measure of progress in 2030. Europe was among the forerunners in adopting the new measure of progress. R&I practices reflect the autonomous efforts of researchers orienting R&I towards people’s wellbeing. R&I organisation adapts to conditions set by the broad variety of researchers' choices ranging from strong emphasis on one’s own wellbeing to full dedication to other’s wellbeing.

Other compositions of societal futures and R&I futures are possible. The selection of the five scenarios in particular is considered to be the most consistent and illustrative of the possible changes in the organization of R&I by 2030.

In the following subchapters the scenarios are described one by one. Each scenario is introduced “in a nutshell” by a brief profile. The actual description consists of three sections:

- From today until 2020: This section explores the conditions of change that lead to a core tension or dilemma in R&I around 2020.
- From 2020 until 2030: This section describes the fate of the core tension or dilemma in R&I, brings a transformation trigger in, and unfolds subsequent transformation processes.
- The research landscape 2030: this section presents the transformed research landscape in general and including distinctive details.

The scenarios are enriched by graphics to ease intuitive sensing of the key characteristics and messages.

The dynamics and outcomes of the scenarios are compared in chapter 3.

2.1 Open Research Platforms – Self-governance in a decentralized research landscape

Explorative scenario	
Conditions of change	The limits to govern the ever more fragmented research and innovation (R&I) landscape towards large missions become apparent. Open research models remain marginalised despite worldwide tendencies towards open knowledge sharing and collaboration in other domains.
Core tension	Ongoing fragmentation of R&I and conflicting actor strategies (e.g., open versus closed R&I) make R&I coordination difficult (here: in a global emergency case caused by a deadly disease).
Transformative scenario	
Trigger and transformation	In the face of a newly emerging deadly disease, scientists worldwide integrate their findings on an open wiki platform and collaboratively discover a solution. Major success cases of open collaborative research contribute to the global rise of Open Research Platforms (ORPs) as a means of research self-governance.
Outcomes	Self-governing ORPs dominate the global research landscape in making extensive use of advanced and pervasive ICT. New licensing arrangements, business models and academic reward systems for open collaborative research are in place. Governments worldwide embed their R&I policies into the research flows passing through ORPs by soft coordination activities and provision of incentives to research groups to contribute to certain ORPs of public interest.

From today to 2020

As public debates on relevance and efficiency of research are intensifying throughout the world, the EU undertakes substantive efforts to coordinate R&I policies. The coordination of R&I is complicated by the exploding complexity of the R&I system and conflicting stakeholder strategies. Governments worldwide increasingly recognize the limits to govern and coordinate research agendas towards large missions (e.g. global pandemics) in an ever more fragmented R&I landscape.

Meanwhile, globally open science communities are rising in a context where “closed science” still remains the dominant mode of knowledge production and communication. With the aid of digital media, people increasingly take up open knowledge sharing and collaboration. Therefore, open collaborative research and publishing flourish — however not without difficulties in relationship to persistent traditional behaviors.

From 2020 to 2030

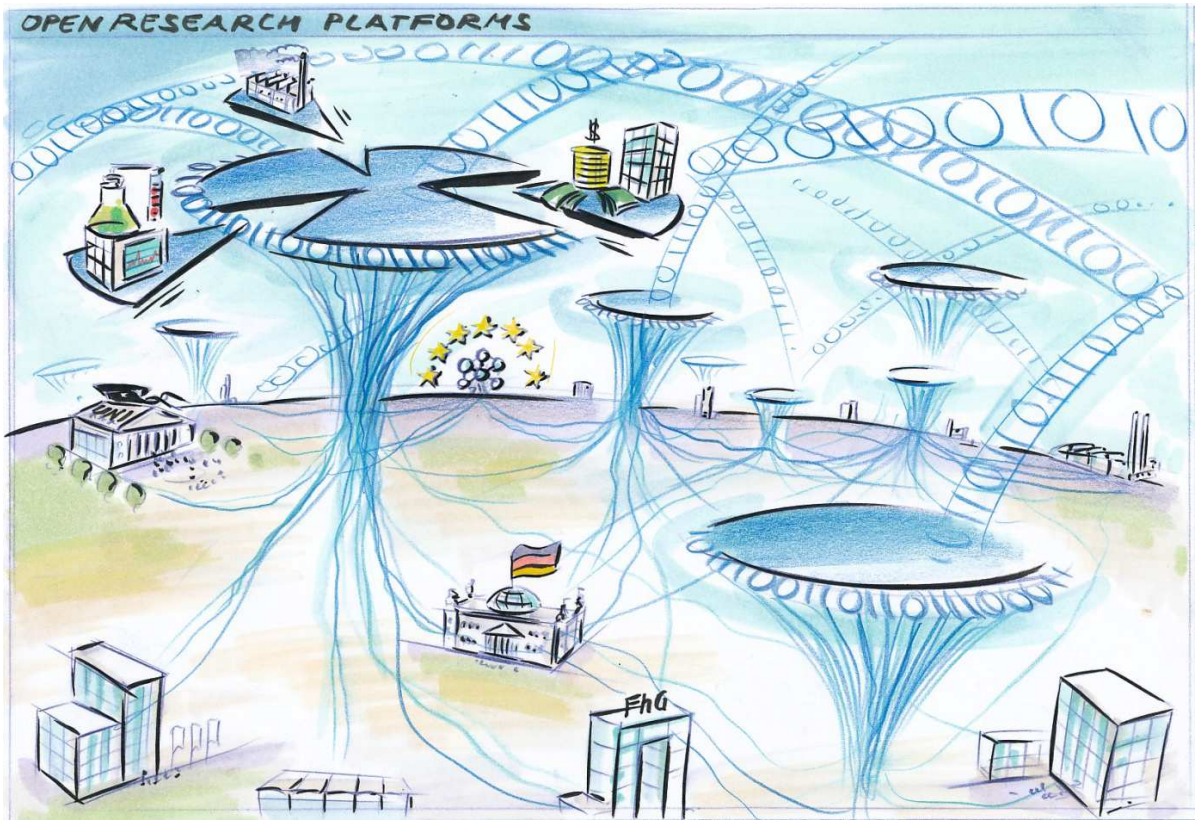
At the turn of the year 2020 a hardly understood deadly disease is spreading at lightning speed around the world. Governments at all levels put up emergency task forces to coordinate governments, universities, industry, intermediaries, and other actors to find countermeasures. EU Member States’ interests stay disconnected as a result of deepened fragmentation and isolation. The pharmaceutical industry claiming exclusive exploitation of the research results is challenged by the prevailing openness paradigm. The actor landscape is fragmented into too many activities with too diverse goals, interests and focus areas.

When the pandemics set in, thousands of scientists worldwide begin integrating their research findings into an open wiki platform on that deadly disease. Within a few months an effective drug is discovered and protected by an open-source license. Research and Technology Organisations (RTOs) pave the ways for manufacturing, licensing, marketing approval and dissemination of the new drug.

The emergency case gives a strong push towards self-organised research collaboration via open platforms. Due to the fact that some actors (certain businesses, countries, etc.) specialize in exploitation of research only, Intellectual Property Right (IPR) regimes are discussed controversially. Yet, open collaborative global research is too dynamic to let any regime effectively regulate IPRs.

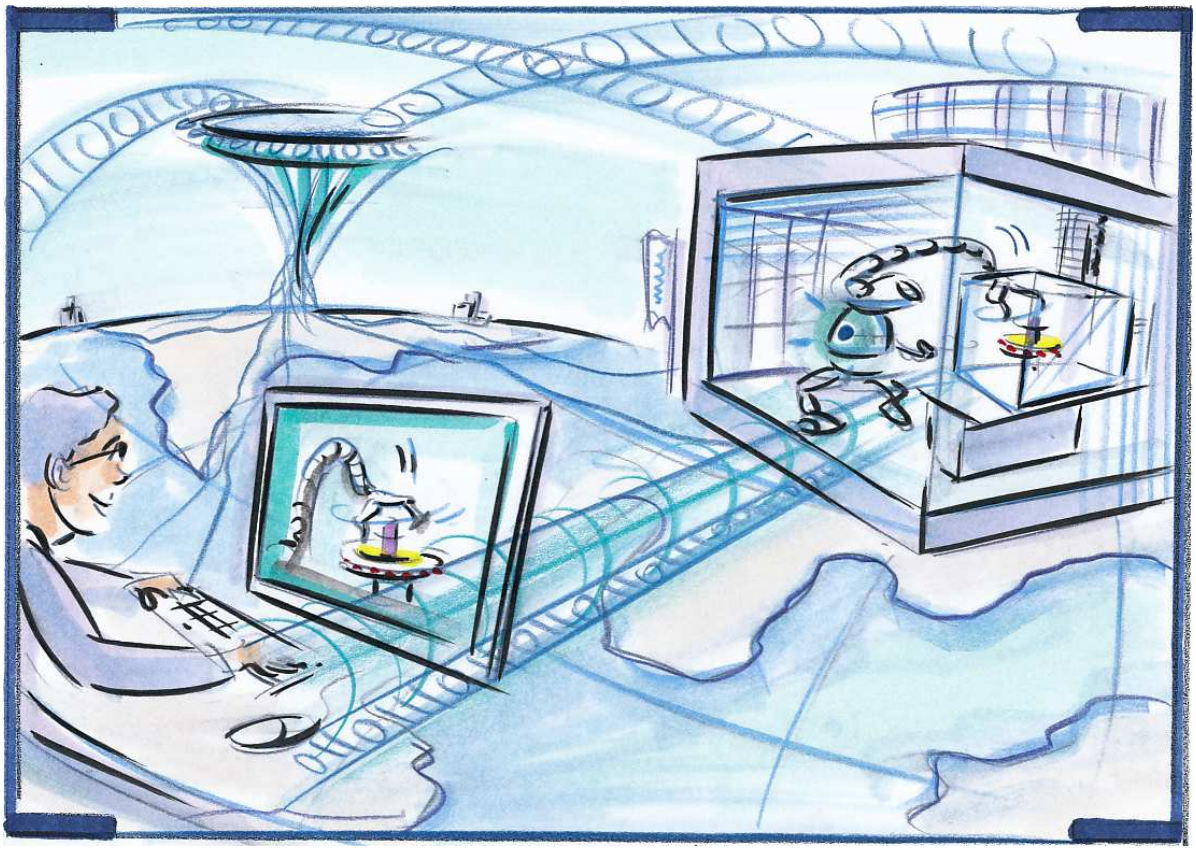
The research landscape 2030

In 2030, research activities are fully decentralised and dispersed over the globe. "Open Research Platforms" (ORPs) facilitate Web 3.0 collaborative research, each ORP focusing on a particular challenge. ORPs are open to society at large and dominate R&I activities of universities, RTOs and large parts of industry in Europe and other open societies.



ORPs are predominantly self-governed. They constantly monitor research and automatically generate patterns of new and interesting research, thus creating their own research agendas. New ORPs come into being bottom-up: from the initial idea, over analysis and representation of growth, until a critical mass is reached. Funding agencies (public, commercial, charity, civil society groups, etc.) monitor ORP dynamics by own tools to adapt funding policies and allocate funds to certain research groups.

ORP research uses advanced data mining and semantic analyses to generate new hypotheses from open data (e.g. from laboratory research, pervasive sensing). ORPs match a researcher's input continuously with the input of others, and link persons with similar research interests. Research overlaps are notified in real-time thus disclosing research repetition. Next generation collaboration tools further stimulate co-operations (real-time language translators, high-quality 3D virtual meeting rooms, robotic tele-presence in practical laboratory research, etc.). ORP algorithms ensure target-oriented collaborative research campaigns.



ORP research is vulnerable to cyber-attacks, for example insertion of misleading data into the open data system. To prevent fraud, all active ORP contributors have to identify themselves allowing for to tracing research to an individual person. Deeper access to ORP research is bound to a certain level of reputation which can be increased by network linkages and provision of high-quality data. Research results are published directly by self-authoring or mediated by peer review. The vast global expertise tied to an ORP allows for broad reviews of contributions within a week or two incentivised by the mutuality principle (i.e. the person who reviews quickly will also be reviewed quickly). The importance of scientific publishers for public research-performing organisations is minor as their performance is now judged by their contribution to ORPs.

If any research is licensed at all, the open-source principle is applied. Thereby industry competes to be first and best in the transfer of ORP research into innovations. Some ORP domains are not open as proliferation could be dangerous (e.g. parts of nuclear energy, synthetic biology).

In the decentralised world the importance of supranational governmental entities such as the EU is limited while national and regional governments remain more important. Worldwide national and regional governments embed their R&I policies into the massive and diverse flows of research through ORPs, namely by monitoring of research, assistance in connection with research activities, and targeted provision of incentives for researchers' groups to contribute to certain ORP activities of public interest. The EU's R&I policy focuses on topics of pan-European interest. National governments keep providing research infrastructure, while higher education follows research into the Web 3.0.

2.2 Knowledge Parliaments – The free negotiation of knowledge claims

Explorative scenario	
Conditions of change	The predominant "science as usual" model of research is increasingly conceived as too narrow to meet societal needs inducing at the same time a reassessment of non-conventional knowledge claims. Grassroots movements and advocates of alternative epistemologies defend the epistemological wealth of the world against both ignorance of its value, and appropriation and unlimited exploitation for commercial purposes.
Core tension	A worldwide struggle breaks out between scientific expert & other forms of knowledge, such as indigeneous and lay knowledge, competing for credibility & legitimacy, and funding (here: in the field of biodiversity and biotechnology).
Transformative scenario	
Trigger and transformation	"Fair knowledge" movements emerge, the European grassroot initiatives linking up to allies across the world. Civil society withdraws from government-controlled Responsible Research and Innovation (RRI) and aligns with public research organisations and local initiatives to initiate and conduct research on hitherto neglected or company "owned" themes.
Outcomes	Knowledge Parliaments evolve into a new governance model for R&I. They provide an arena for the free negotiation of knowledge claims thus bringing neglected research topics, epistemologies and knowledge types to the fore. A significant share of public R&I budgets is left over to allocation by voting of interested parties. Democratic societies regulate diverse epistemic cultures in knowledge parliaments; less democratic societies either dictate legitimate knowledge types or do not regulate knowledge legitimacy at all.

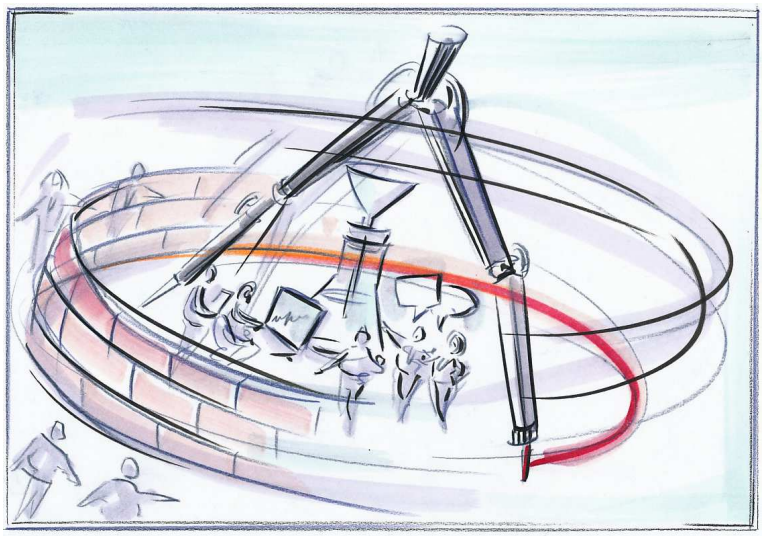
From today to 2020

The scope of knowledge covered by “science-as-usual” is more and more turning out to be too narrow to meet societal needs and to find legitimation in a world that is becoming progressively interconnected. Inspiration and innovation are increasingly expected from unconventional knowledge domains (e.g. indigenous farmers' knowledge). The decisive role of San tribe members from Namibia in deciphering the stone age works in the French Volp caves in 2013 was received with great interest in the EU public at large, and set the wheels in motion for a re-assessment of the value of non-Western non-academic knowledge.

Meanwhile, grassroots movements and advocates of alternative epistemologies from the global South (e.g. Machiguenga People from Perú) and other non-mainstream-science movements from the Western hemisphere (such as the French Association of Patients with Muscular Dystrophy) are seeking to defend the epistemological wealth of their regions and their people. On the one hand, they blame the claims that conventional science should be the sole source of scholarly justification thus ignoring the value of alternative epistemologies and non-mainstream knowledge for society, on the other they act against appropriation and unlimited commercial exploitation of the world's epistemological wealth through state- and enterprise-promoted research programmes.

From 2020 to 2030

A worldwide redistribution struggle brakes out: between “modern” scientific expert knowledge and traditional or lay knowledge, modern technology companies and, e.g. regional biodiversity, and conflicting definitions of IPRs. The struggle basically goes over how far research should serve the interests of either biotech companies only, or local traditional communities thus equally acknowledging their knowledge. “Fair knowledge” movements take up thoughts known in public from the “fair trade” movement such as transparency, responsibility and equal opportunities. Grassroots initiatives in EU Member States start to link up with their allies across the world, learning from them how to become partners for research meeting their local needs.



“Responsible Research and Innovation” (RRI) has been engaging the European public in debates on R&I topics and ethical issues to account for societal knowledge claims on a local and global scale. Nevertheless industry, established science, and governments are still dominating advisory boards and programme committees. Public deliberations are increasingly perceived as burdensome and

time consuming. Civil society is dissatisfied with current modes of policy-making based on corporatist representation and with too rigid and inflexible participation procedures in closed-circle activities, because the best-organised interests (e.g. of large businesses and NGOs) prevail over the interests of others. Therefore, civil society actors quit RRI participation and align with public research organizations and local initiatives in their countries and world-wide in order to develop projects and seek funds (from NGOs, philanthropic foundations, crowd-funding, civil society projects, etc.) for R&I on hitherto neglected or company "owned" issues.

The research landscape 2030

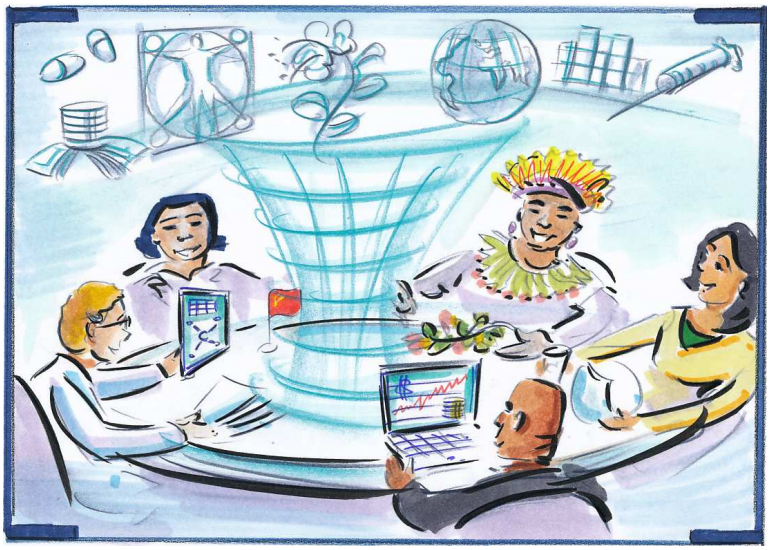
Around 2030, a new science-in-society contract has evolved from these flourishing new networks of organisation and practice. Governmental R&I budgets opened up for these research practices. All kinds of knowledge claims are brought to the fore and negotiated in the so-called 'knowledge parliaments' summoned ad hoc, on demand, by interested parties.

The knowledge parliament is an open arena format that accounts for all research interests, topics and epistemologies not adequately covered by governmental administration's research agendas. Knowledge parliaments operate through three main mechanisms:

1. Authorities at various levels, involved in R&I in a broad sense, leave a certain share of their R&I budget to be allocated by its citizens (available on demand). Regular voting decides over which R&I topics to be supported with these funds.
2. The allocation of funds takes place in a "research stock exchange". Research consortia compete for "research stocks" that specify research needs and funding.
3. Knowledge parliaments provide a sphere in which research interests, topics and epistemologies compete for acceptance and facilitate the building of research consortia that may encompass any kind of stakeholder, and in particular advocates of unconventional knowledge. These consortia go for "research stocks", or other funds (e.g. from foundations, crowd funding, societal research beneficiaries such as municipalities).

Across all EU public R&I budgets, the knowledge parliaments' overall share rises to almost 40%. The right to vote is not bound to citizenship, and all kind of actors from all over the world engage in the knowledge parliaments. The meetings are held anywhere on the globe when required, also using online forms of gathering.

Research in the knowledge parliaments is initiated by civil society (e.g. patient groups, social enterprises) or by research consortia. A project's cooperation culture is shaped by the latent cooperation practices in the consortium that looks for suitable funding, thus replacing the adaptation of consortia to predefined cooperation mechanisms in research programs. In the consortium building phase knowledge claims are preselected through free negotiation by representatives from all relevant knowledge domains. This brings alternative knowledge domains to the fore.



Projects are characterized by a common framing of the task, but incompatibility of knowledge types and specialized expertise require a division of labour in the research process. Actors of the diverse knowledge domains dispose of strong communicative and intercultural skills, as well as of transdisciplinary competences to combine various knowledge types meaningfully. The boundaries between citizens and experts in research projects are extremely permeable. The power of the arguments raised in fair procedures not only dominates in the way research is done, but also in the negotiation of ownership and exploitation of research results. As the various actors have different views on how to provide evidence for knowledge claims, the definition and assessment of research quality ranges from controversial debates to a consensus that anything goes, whereas pure science lost its monopoly to prove evidence.

Most universities are open to several epistemic cultures, preparing students for the miscellaneous requirements related to the understanding and integration of various knowledge types. Working under these open conditions is sometimes stressful, but is rewarded by publicly accountable, socially relevant research outcomes, while also offering interesting research opportunities. Science shops, new kinds of media, and specialized mediators engage in bridging and translating the different epistemic cultures into each other.

The knowledge parliaments produce knowledge that increasingly amends, challenges and replaces "orthodox science" solutions. While other democratic societies regulate diverse epistemic cultures

similar to Europe in knowledge parliaments, less democratic societies either dictate legitimate knowledge types or do not regulate knowledge legitimacy at all.

Over time knowledge parliaments reshape the global landscape with its plurality of knowledge, various regimes of intellectual property rights, and research styles. The preceding crisis of democratic representation, felt also in the research policy field, is overcome by increased participatory negotiation over what research shall be carried out to which end, financed by what resources, and generating how much profit and for whom.

2.3 Grand Challenges for Real – Collective experimentation in socio-technical labs

Explorative scenario	
Conditions of change	Globally, research on Grand Challenges is expected to open up major economic opportunities. The organisational model of Knowledge and Innovation Communities (KICs) focusing at research and technology, higher education and business exploitation is adapted to Grand Challenges by the EU.
Core tension	Societal unease in Europe about the failure of conventional R&I programs to address pressing societal challenges effectively (here: a severe draught) is growing.
Transformative scenario	
Trigger and transformation	In the aftermath of a successful socio-technical experiment public claims in Europe intensify to take Grand Challenges seriously and involve citizens in R&I. Learning processes induced by collective experimentation involving technology as well as social practices emerge and diffuse broadly.
Outcomes	The EU's KIC concept is reframed to accommodate new experimental forms at centre stage, without favouring any particular kind of innovation. Each KIC oversees a number of socio-technical laboratories for collective experimentation. Doing research and idea generation are closely intertwined, as experimentation in socio-technical laboratories, measurement of practices and impacts in the field, and co-creation go hand in hand. On a global scale, the EU pursues a special path in directing Grand Challenges research towards real solutions that may, but not necessarily, foster economic growth.

From today to 2020

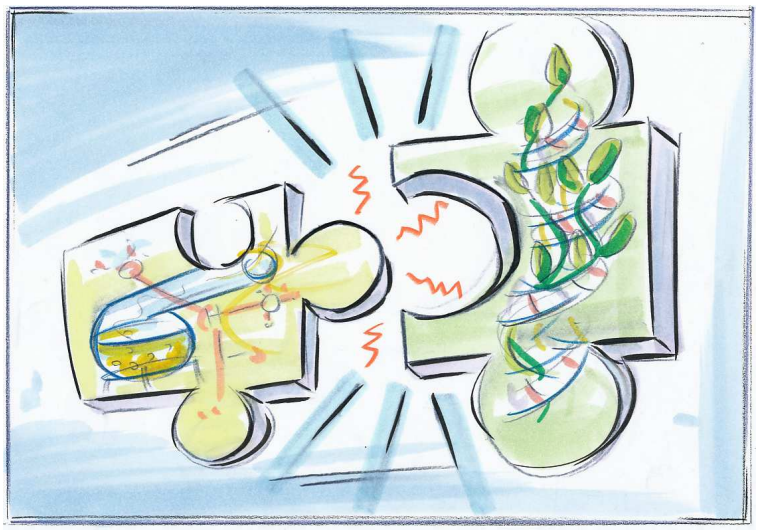
The world increasingly recognizes the "Grand Challenges of our time" (e.g. climate change) as a key issue for R&I. When China launches a massive investment campaign in research on Grand Challenges, European business sector organisations align with EU's R&I policy to make research on Grand Challenges a vehicle to foster economic growth in Europe ("Grand Opportunities").

EU R&I policy formulation and coordination bodies adapt the concept of Knowledge and Innovation Communities (KICs) of the European Institute of Innovation & Technology to Grand Challenges with the ultimate aim to stimulate Europe's economy. These new KICs (e.g. Water-KIC, Climate Change-KIC, Health-KIC) focus on research and technology, higher education, and business, and attract more and more public as well as private funds. The academic and research community reformulates their profiles according to the new "Grand Challenges as Grand Opportunities" headings.

From 2020 to 2030

At the turn of the decade, Southern Europe is facing several long-lasting and severe draughts. Harvests are lost, tourism recedes and industry branches collapse.

The most resilient regions have been experimenting collectively, i.e. society tried out things and learnt from it, long before. Shifting the accent from research on particular technologies towards collective goals stimulates experimenting with any idea - from new social practices over diverse high-tech and low-tech solutions to combinations. The feedback cycle of trial and error, impact measurement, learning and invention allows for demonstration of evidence for real progress. Collective experimentation has gradually changed citizen lifestyles towards water-saving and engagement in novel collective practices. In contrast, the Water-KIC taking "Grand Challenges as Grand Opportunities" has developed sophisticated solutions which however are not applicable or do not work effectively in most European regions.



As the markets failed to deliver solutions to tackle Grand Challenges effectively, the European public, in particular Civil Society Organizations (CSOs) and media, start to demand serious citizen involvement and cost-effective solutions in governmental R&I programs on Grand Challenges. In the inter-ministerial conflicts that follow, the voices calling to take Grand Challenges for real cannot be suppressed any more. The KIC-concept on Grand Challenges is re-conceptualized to accommodate

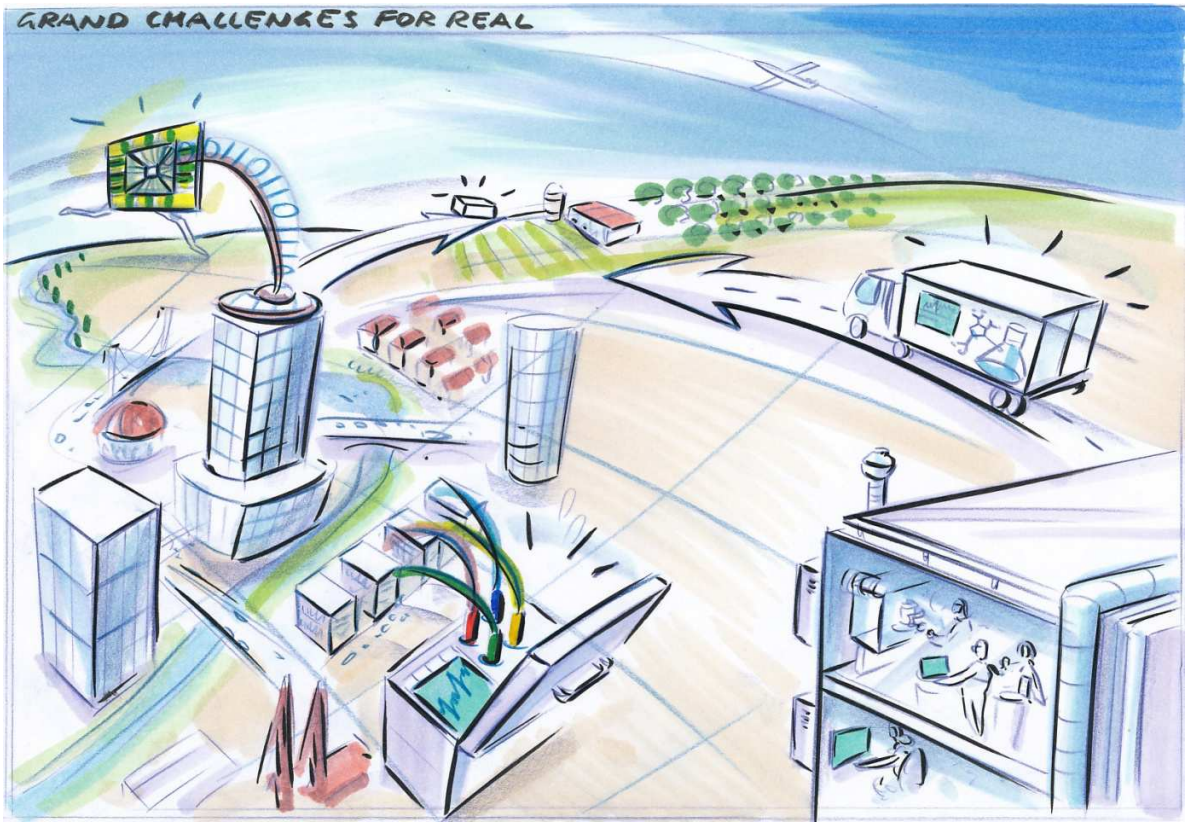
collective experimentation at centre stage. Thereby it opens up to new actors (e.g., civil society), other science domains (e.g. neglected social sciences and humanities), and new experimental forms without favouring any particular kind of innovation.

The sheer size of the task, to tackle Grand Challenges on a pan-European scale effectively, puts the EU into the driver's seat to program and coordinate R&I on Grand Challenges across all governance-levels in Europe. When the EU decides to assign a large share of R&I funding to a few KICs on Grand Challenges, member states, regions, industry, the academic and research community, and civil society begin fierce lobbying with regard to the choice, scope, tasks, and actors' roles. As a powerful supranational union the EU is both able and determined to formulate a successful configuration, to demand payment contributions from national and regional governments and to diffuse it over the whole R&I system under political pressure.

The research landscape 2030

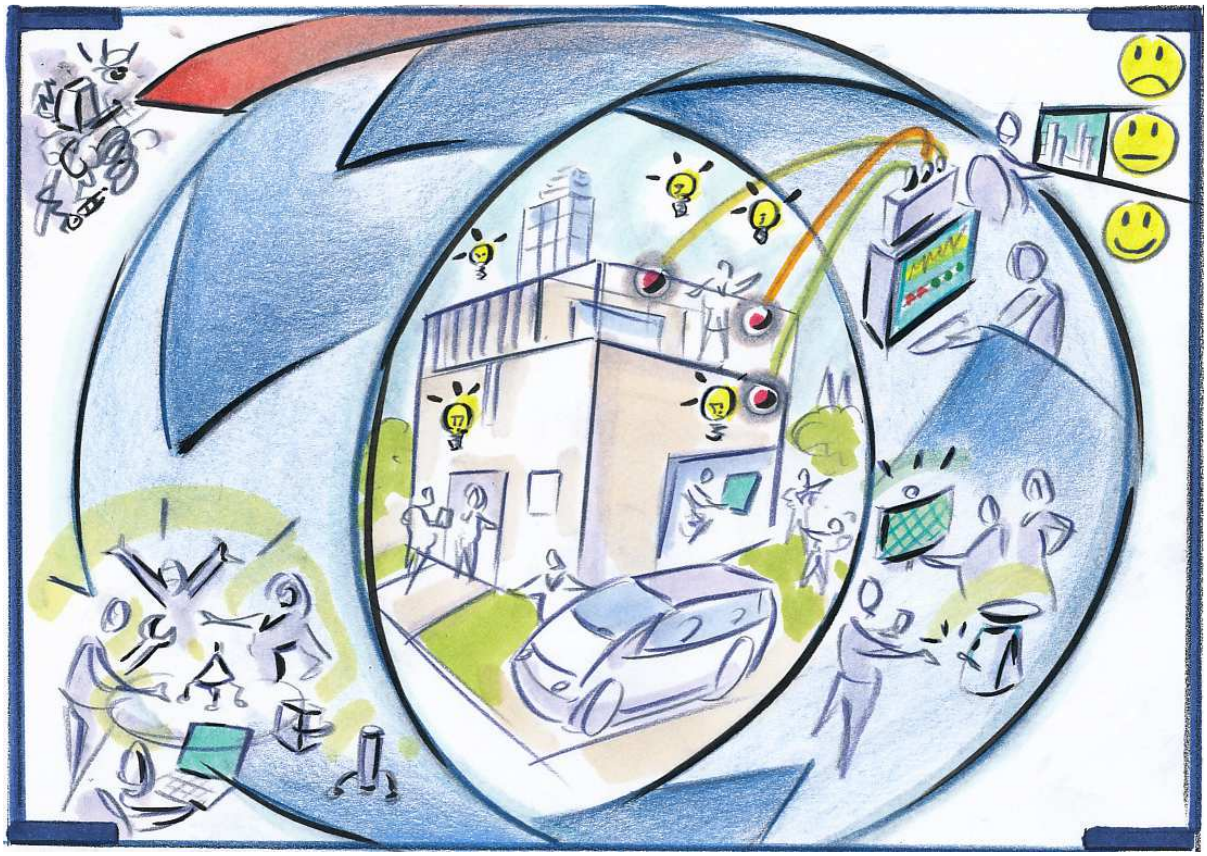
In a multipolar world, Europe focuses on solutions for Grand Challenges in order to solve societal problmes rather than foster competitiveness of the EU's economy alone, while the other world powers take Grand Challenges for real only if they foster economic growth significantly.

In 2030, large parts of R&I in Europe make use of collective experimentation. In particular research on Grand Challenges is organized around certain Knowledge and Innovation Communities (GC-KICs). These GC-KICs receive large funds from the European Union and its Member States to discover novel solutions by collective experimentation, to provide evidence of progress, and to implement the novelties in practice. These experiments take place in socio-technical laboratories that encompass physical and virtual, stationary and mobile infrastructures, and reality itself that is pervaded by laboratory equipment (e.g. ubiquitous sensing) and design tools (e.g. 3D-printers).



Each GC-KIC oversees a number of socio-technical laboratories in which different solutions are developed and tested. As an example, elderly-care concepts are pioneered in East Finland, Saxony (Germany), and Northwestern Italy to ensure that research stays diverse. While the basic orientation of GC-KICs is preset by long-term policy planning, the agenda setting within the GC-KICs is facilitated by multi-stakeholder committees installed by the EU, combining top-down and bottom-up processes. The socio-technical laboratories are open to all stakeholders and results are fully accessible to allow for adaptations in diverse contexts.

Socio-technical laboratories are equipped with sensor arrays measuring numerous parameters real-time (e.g. “Lab on a Chip”), augmented reality interaction technologies, play-like 3D design tools, and they are dynamically modifiable. Diverse actors such as citizens, companies, universities, social entrepreneurs, and NGOs take part in regional experiments. People adhering to post-material wealth lifestyles use socio-technical laboratories to test their behavior under real-world conditions and to generate inventions conducive to their preferred lifestyles. Doing research and idea generation are closely intertwined, as experimentation in socio-technical laboratories, measurement of practices and impacts in the field, and co-creation go hand in hand. This combined approach leads to a boost in the number and variety of inventions. An integrated impact assessment approach (addressing problem-solving potential, social acceptance, etc.) enables fast and goal-directed selection of inventions.

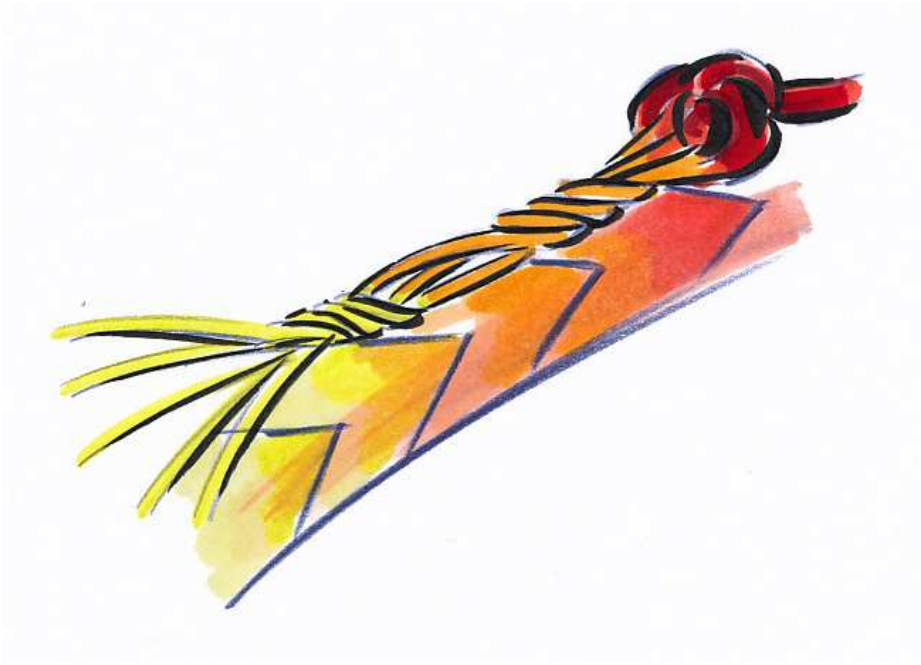


Universities collaborate within respective regional communities. Higher education links up to collective experimentation in using the socio-technical laboratories for testing, teaching and learning. Companies value GC-KICs for their insights into potential collaborators as well as customers' values, lifestyles, and behaviours. They support experimentation by provision of technology, products,

services and systems, and they are encouraged to transfer experiences into open innovations. Public socio-technical laboratory infrastructure stimulates the innovation capabilities in particular of SMEs. User-organisations, design entrepreneurship and developer communities flourish. Science provides approaches to tackle Grand Challenges at regional level that have to be adapted to concrete regional circumstances. Design research becomes a leading science that integrates tacit knowledge, arts, engineering, craft, prototyping, social science and other knowledge domains. Research quality is assessed by the communities of practice in GC-KICs. Excellence is redefined considering the facilitation of collective experimentation and the contribution to the achieved actual progress. Regional development organization networks play a major role in interregional knowledge transfer.

EU and member-state governments provide socio-technical laboratory infrastructure and frameworks for conducting and controlling collective experimentation, and sharing of investments and benefits. EU member states also fund basic research and higher education to support the GC-KICs. EU's R&I policy is a horizontal activity covering different sector policies, for example on demographic change and infrastructure. Businesses and states copy and adopt successful collective experimentations and inventions worldwide.

2.4 Knowledge Value Chains – Research for innovation in a specialized and stratified research landscape



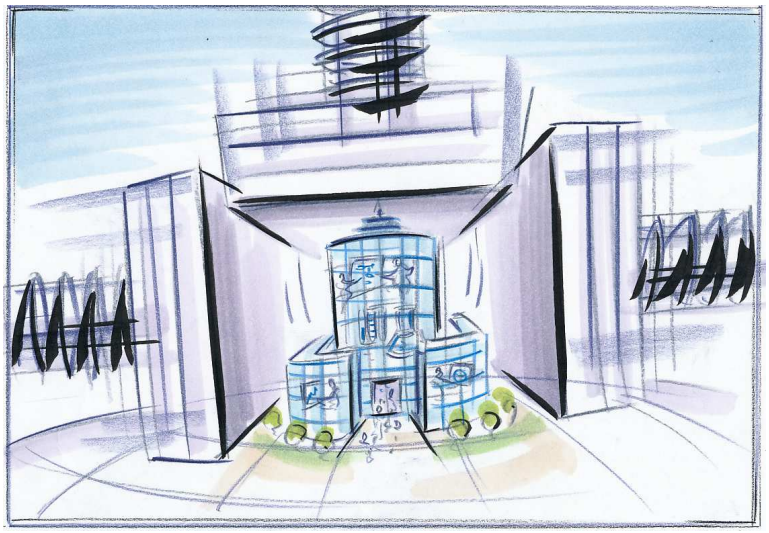
Explorative scenario	
Conditions of change	"New Public Management" (NPM) is reinforced worldwide to evaluate and govern the ever more fragmented research and innovation (R&I) landscape, and fewer but larger projects are funded. The global race for technological innovation leadership is accelerating further.
Core tension	A boost in efforts for fund raising & evaluation and stiff competition for limited research funds increasingly put pressure on Research-Performing Organisations (RPOs).
Transformative scenario	
Trigger and transformation	Consultancy-led (and similar) consortia prove their strengths in efficient research management in an EU R&I program on electromobility. Specialized consultancies, businesses and RTOs take leadership in running large-scale complex "projects that deliver" efficiently.
Outcomes	RPOs specialise and stratify, operating in three-tiered Knowledge Value Chains (KVCs): 1. Research Integrating Organisations (RIO), 2. Research Service Organisations (RSO) and 3. Third-tier providers of fragmented research contributions. KVCs rationalize research by applying business management principles, and continuously direct research towards innovation in close cooperation with industry. Governments worldwide support their industry and RPOs to play an active role in the globally operating KVCs.

From today to 2020

Governments worldwide reinforce “New Public Management” (NPM) to evaluate and govern the ever more fragmented landscape of research-performing organisations (RPOs). The administrative bodies of research and innovation (R&I) increasingly fund fewer, but larger projects. Government expenditure on R&I in Europe is reduced because of persisting economic constraints. Focussing on results and efficiency leads to the opening-up of funding programmes to non-European and other new applicants to get the best research services at the lowest possible price.

By 2020, Europe is lagging behind the USA and/or Asia in key technologies (such as energy storage, nanotechnology) and in key enabling industries (such as microelectronics and biotechnology).

From 2020 to 2030



At the turn of the decade, RPOs experience significant pressure for fundraising and evaluation and face stiff competition for limited funds. RPOs operating according to consultancies’ practices manage best to comply with increasing economic pressures. Consultancy-led research consortia (or similar forms of organization) are generally encouraged as it was such consortia that delivered the best results in the most efficient way in a large research program on electromobility involving EU, member-state and regional governments. Therefore, consultancies and businesses have slowly taken over leadership in research aiming to improve Europe's position in the global innovation race.

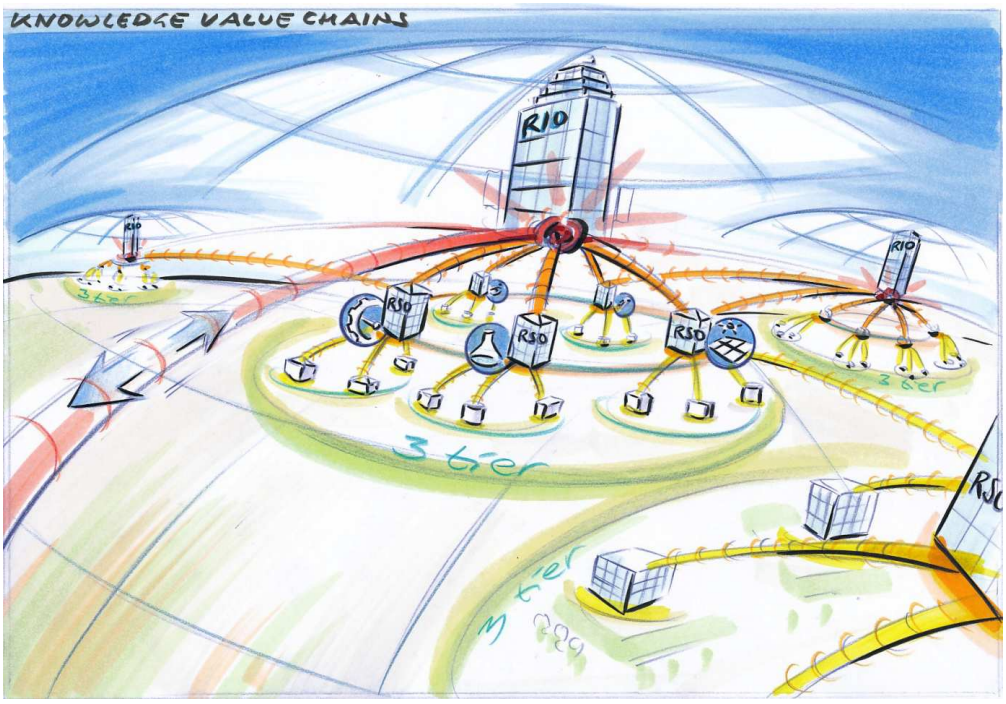
Responding to the new conditions of R&I funding worldwide (e.g. few large projects, focus on efficiency and results, tightly contested funds), only a small number of organizations manages to focus on system competencies and on professionalization of project management, fundraising and marketing. They succeed in fundraising regardless of declining public funds because of close cooperation with industry, highly efficient project management and international sourcing. Selected contractors are increasingly big and powerful to cover the commercial risk of research projects, among them consultancies, RTOs, international universities and large private research organizations. As a survival strategy most universities (or university departments) and smaller RPOs opt for specialization in certain research fields and subcontracting. This division of labour, which is now transforming the global research landscape, had been forestalled in Life Sciences earlier.

The research landscape 2030

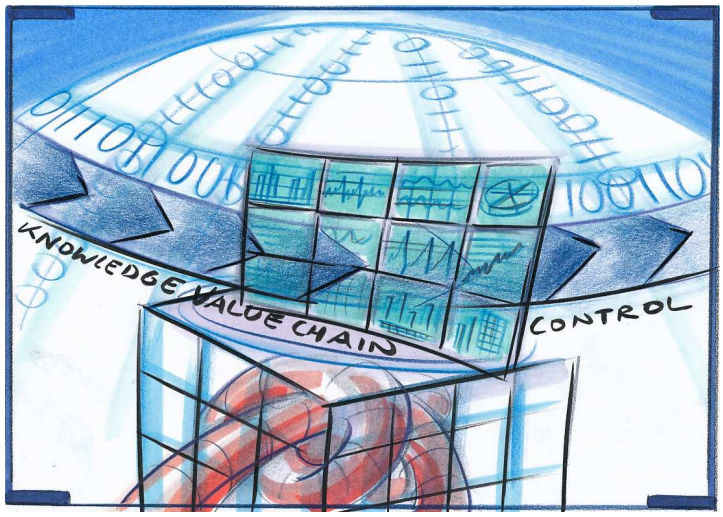
In 2030, the main purpose of research all over the world is to foster innovation for economic competitiveness. Public and private research is closely intertwined. The desired system solutions are realised by consortia comprising highly-specialised and stratified organisations of three types:

1. Research Integrating Organisations (RIOs) dispose of system and knowledge management competencies, and insider knowledge of the research market. They are large, operate globally, and have access to governments worldwide as well as to the management of internationally operating companies.
2. Research Service Organisations (RSOs) provide in-depth knowledge in specific fields. They are small- to medium-sized, agile actors with good networking competencies.
3. Third-tier organisations supply data and fragmented research contributions. They comprise a variety of actors with field access, data appraisal and processing competencies (e.g., laboratories), or creative ideas (e.g. think tanks, freelancers).

The specialization binds all organizations to their position in the knowledge value chain (KVC). Like the OEMs in the value chains in the automotive sector, RIOs manage the co-creation of value with RSOs and third-tier organisations, and sell research products to industry, government, and other customers. KVCs rationalize research by generally applied business management principles (e.g. Total Cost of Ownership), and facilitate innovation-orientation of research in close cooperation with industry.



Research projects are initiated by RIO/industry or they respond to government calls that reflect their research needs negotiated in closed circles. Overall, EU and member-state government expenditure on research for innovation is equal to industrial R&D investment. RIOs employ world class talents able to understand complex innovation tasks, ignite creative processes, and integrate various pieces of knowledge in an integrated solution to a particular problem. Intermediaries assist RIOs in finding suitable partners for a KVC.



The majority of researchers worldwide work in one of the three organization types of KVCs. RIO researchers are assisted by advanced knowledge management systems to monitor, track, and control value creation in real-time and by diversity management systems to foster creative processes. Doing research in RSOs complying with industry's time demands in the KVC is challenging but it favours the development and use of efficient research tools (e.g. seamless human-machine interaction) and performance enhancement measures (e.g. cognitive drugs). Third-tier suppliers of data use large automated data appraisal and processing infrastructures to maximize economies of scale and extract innovation-relevant meaning from data. Third-tier suppliers of fragmented research are active in time windows to deliver a missing piece of the envisaged solution. All research is managed by the RIOs' assistant systems that set standards and define interfaces.

Research quality and impact are defined by business management principles, while compliance is assured by flourishing evaluation organisations. Division of labour and management practices in KVCs disfavour the development of holistic theories. All kinds of knowledge (e.g. data-driven research, trial & error, tacit knowledge) compete with each other, but the measurable ones are favoured as they can be translated into scores relevant for funding and evaluation. At RSOs, the balance of curiosity-driven and mandated applied research inclines towards the latter, RSOs actively promoting the commercial exploitability of their research to attract funding. RSOs publish to demonstrate competencies, though restricted by commercial exploitation interests.

RIOs design research processes and access to results as open or closed, depending on the customer, seeking either open innovation or knowledge protection. RIOs (rarely RSOs) also set the market- or power-based investment and benefit sharing rules within the KVCs. Industry itself conducts own basic research for innovation beyond KVC research, while governments also fund high-risk basic research for breakthrough innovation.

As industry and RIOs drive the setting of R&I priorities, the importance of supranational unions (such as the EU) is downsized. National and regional governments support their industry and RPOs to play an active role in KVCs according to their respective financial strength. The specialisation of research leads to a new dependence on particular world regions and key actors to cover certain scientific fields. National and regional governments fund universities specialised in higher education, conveying competences that integrate the logics of research and value creation. Purely curiosity-

driven research disconnected from KVCs is mainly conducted by a few international, state- or foundation-funded organisations breeding their own top-class researchers.

2.5 Researchers' Choice –
Autonomous researchers go for self-fulfillment and wellbeing

Explorative scenario	
Conditions of change	Pressure on scientists from various directions - in terms of pursuing scientific excellence, competitive funding, commercialization of research, public accountabilities and other societal claims are growing. In the course of repeatedly occurring cases of scientific errors, fraud and lobby-driven expertise, reputation of scientists and trust in science by society deteriorates.
Core tension	Conflicting demands from different directions diminish the attractiveness of ordinary academic careers eventually leading to identity crisis of scientists (here: taking part in university protests).
Transformative scenario	
Trigger and transformation	Individual researchers develop alternative, self-organized ways of doing research. A variety of career models to fulfill oneself in research emerges: science entrepreneurship, slow science, etc. Research tends to be increasingly value-driven and is oriented towards individual values.
Outcomes	Research is directed towards the new governance paradigm that shifted emphasis from measuring economic production to measuring people's wellbeing. Autonomous researchers realize their ambitions in covering a broad spectrum of career models, ranging from new forms of science entrepreneurship to more collective forms under the umbrella of "slow science" with a strong orientation towards local societal needs. Negotiation of framework conditions for science entrepreneurship and slow science remains a constant challenge for policy formulation and coordination bodies globally.

From today to 2020

Pressure on scientists keeps increasing from a number of different directions. More and more scientists feel torn between conflicting demands for scientific excellence, commercialisation, competition for funding, public accountability and demand for societal contributions. Others are unsatisfied with the current system of science quality assessment and evaluation, and with their career options. Working hours keep increasing and the number of burnouts of scientists grows. To many this appears particularly frustrating as societal framework conditions are changing in the opposite direction: more and more people are becoming sensitive to issues of wellbeing and work-life balance and emphasise creativity and individual autonomy as core values.

On top of this, many scientists regard strict regulations, loads of paperwork, increase of competences required and continuous assessments as additonal cumbersome aspects making their work ever less rewarding. At the same time, public reputation of science is deteriorating. Many citizens are of the opinion that the established science system ignores basic societal needs. In spite of the efforts for strict quality assessment, the number of cases of science-fraud, conflicting lobby-driven scientific-expertise, and fatal science errors grows steadily. For this reason, public trust in science and scientists' societal reputation decline rapidly.

By 2020, the attractiveness of ordinary academic careers has diminished severely, many scientists finally facing an identity crisis. In several universities protests are joined not only by students but also by young and senior researchers. The number of young talents aspiring to a career in science falls sharply and several researchers are on the lookout for better working conditions in other areas of the globe.

From 2020 to 2030

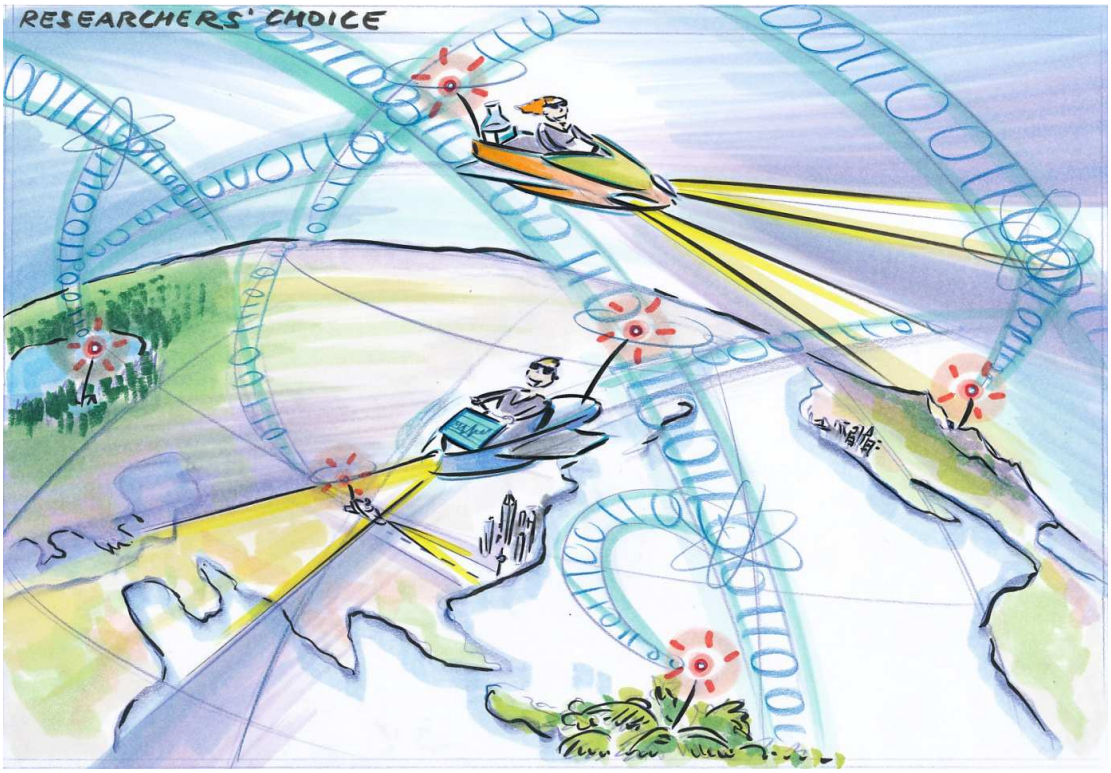
In this tense situation more and more individual researchers take action and develop alternative self-organised ways of doing research. A main driver of this movement is individualism: everyone tries to promote and sell her/his own idea or asset as a way of self-expression and self-fulfilment. Another backbone is the availability of affordable tools (e.g. laboratory equipment, 3D printing, web-platforms) enabling individual research practices as well as seamless self-organised collaboration of autonomous scientists. Virtual science communities are becoming stronger.

Self-organised, autonomous research is rising in different forms: one increasingly prominent format is competition-oriented autonomous science-entrepreneurship developing targeted solutions for global markets. These often highly creative, ambitious talents are motivated by the pleasure of seeing their numerous ideas turned into successful solutions and products and the aspiration of earning high revenues in return to their hard and restless engagement. Another phenomenon on the rise is the so called “slow-science” movement. This nickname is picked up from the “slow food” movement as – similar to the food activists - “slow scientists” strongly advocate quality of life and work as well as sustainability and local embedding of scientific activities. Many slow scientists reduce their professional activities in order to pursue other activities such as arts, sports, friends and care for children and elderly or voluntary support of community ventures. A silent revolution of women takes place, who find their way into research through slow science at the local level and through science entrepreneurship (including micro-businesses). Increasingly locally-anchored women scientists join their forces in a global network including top women scientists from all over the world.

While the science landscape is diversifying, society is changing as well. New indicators for measuring progress emphasising quality of life rather than only economic growth are established in many countries. As research emerges to be value-driven and oriented towards individual values, researchers increasingly question the established mechanisms of measuring scientific excellence.

The research landscape 2030

In 2030, bottom-up self-organised research is the norm. Research is oriented towards the new governance paradigm that shifted emphasis from measuring economic production to measuring people’s wellbeing. The autonomous researcher, coming forward as slow scientist or acting as science entrepreneur, has gained social acceptance and represents the prevalent researcher’s career. Many ambitious young talents are working and striving for entrepreneurial success and societal reputation through science entrepreneurship and slow-science activities.



Slow science builds a “glocal” network, as hubs with a strong local orientation spread all over the globe networked together and in exchange with each other. Slow science is supported financially by foundations, citizens’ initiatives, and through crowd-funding. The quality of slow science activities is measured by its contribution to society’s needs which is assessed in close interaction with the local users and through virtual science communities. Most slow science communities publish research findings on special online platforms and request voluntary contributions for each download.

Local governments collaborate with slow science communities to get independent advice on local-level research questions. Many universities strengthen their local mission and collaborate with slow scientists. For the development of new system solutions for local demands slow scientists collaborate with local companies under the coordination of local governments. City and municipality networks adopt new roles in the transfer and local adaptation of slow science solutions.

Science-entrepreneurs offer their research services to various societal actors (SME, big industry, governments, NGOs, etc.). They work autonomously connected to other science entrepreneurs through virtual platforms for exchange and collaboration on a project base. Many of them publish their results and live of the fees per clicks and number of downloads. This kind of revenue generation has become an important source of science funding with an impact on selection of research topics.

Perpetual auditing, impact assessment and evaluations are no longer required and burdensome New Public Management (NPM) principles have been abandoned. Publication speed and extent is determined by the interests of the autonomous researchers themselves, who are motivated by recognition in their peer communities and feedback from the users of their results.

Governments nurture science entrepreneurship by lowering the entry-barriers to business start-ups. At the business entry-level, an advanced feedback system supports the autonomous researchers’ in their careers and protects their ideas. Thus, they have an indirect coordination effect. Because of the wide variety of researchers’ choices to deliver research-based solutions for markets and societal needs, ownership of research results and IPRs are very controversial. Negotiation of adequate framework conditions for science entrepreneurship and slow science remains a constant challenge for international councils, EU institutions, and for national governments.

3 Comparison of the scenarios

This chapter compares five RIF scenarios presented above. The commonalities and differences of the scenarios are reflected, first, for the scenario dynamics covering the critical stage from explorative to transformative scenarios, and second, for the scenario outcomes addressing the guiding questions.

3.1 Comparison of scenario dynamics

The RIF scenarios are built on the assumption that developments in society and in R&I lead to tensions and dilemmas that may eventually cause transformative change. This transformative change has very different origins in the five scenarios.

The core tensions and the key transformation triggers of the five scenarios are displayed in Table 3.1.

Table 3.1: Comparison of dynamics around 2020 in the RIF-scenarios (Source: RIF)

	Open Research Platforms	**Knowledge Parliaments**	**Grand Challenges for real**	**Knowledge value chains**	**Researchers' choice**
Core tensions	R&I coordination problems due to ongoing fragmentation & conflicting actor strategies (e.g. open vs. closed R&I)	worldwide struggle between "modern" scientific & other forms of knowledge for credibility & legitimacy, and funding	growing societal unease about the failure of conventional R&I programs to address pressing societal challenges effectively	a boost in efforts for fund raising & evaluation and stiff competition for limited budgets increasingly put pressure on RPOs	diminishing attractiveness of ordinary academic careers eventually even leading to identity crisis due to conflicting demands on researchers from different directions
Transformation trigger	In the face of a newly emerging deadly disease scientists worldwide integrate their findings on an open wiki platform and collaboratively discover a solution.	"Fair knowledge" movements emerge, the European grassroot initiatives link up to allies across the world.	In the aftermath of a successful socio-technical experiment claims intensify to take Grand Challenges seriously and involve citizens in R&I.	consultancy-like RPOs manage best to cope with pressure and consultancy-led (and similar) consortia prove their strengths in an EU program on electromobility	individual researchers develop self-organized ways of doing research

Note: KIC – Knowledge and Innovation Community; R&I – Research and Innovation; RPO – Research Performing Organisation

The conditions of change in the five scenarios cover a broad variety of developments. They represent a dynamically changing R&I environment and changes in R&I itself that eventually lead to the core tensions around 2020. In two cases the core tension is a failure of R&I to deliver on societal needs which becomes apparent in "acid test" events. In the *Open Research Platform* scenario coordination of R&I is hampered by fragmentation and conflicting stakeholder strategies in a global emergency case. In the *Grand Challenges for Real* scenario the "Grand Challenges as Grand Opportunities" approach proved ineffective in a socio-ecological disaster (the severe draught). In the three other

scenarios the tensions appear mainly as conflicts of interest: the *Knowledge Parliaments* scenario holds a worldwide redistribution struggle between „modern“ scientific and other forms of knowledge (i.e. originating from other epistemic cultures), the *Knowledge Value Chains* scenario describes stiff competition among research organisations in times of economic constraints calling for more efficient management and ways of doing research, and the *Researchers' Choice* scenario features the diminishing attractiveness of usual academic careers eventually leading to identity crisis of scientists due to conflicting demands from different directions. Several scenarios contain additional tensions that are relevant to the transformation processes.[7]

Each transformation process has a certain trigger. The tensions or dilemmas eventually either force the current institutional settings to open up to new actors and their views, or a divergent behavior of certain actors induces transformative change. Divergent behavior from the ‘mainstream’ dominates as the trigger in the *Open Research Platform* scenario (scientists integrate findings on open wiki platform), in the *Knowledge Parliaments* scenario ("Fair knowledge" movements emerge), and in the *Researchers' Choice* scenario (individual researchers develop self-organized ways of doing research). These trends are already evident to some extent today and eventually turn into mainstream R&I models in 2030. Opening up of the current institutional settings dominates as the trigger in the *Grand Challenges for Real* scenario (opening up of Grand Challenges R&I to new actors, new methods, new experimental forms), and in the *Knowledge Value Chains* scenario (pronounced encouragement of consultancy-led or similar consortia to conduct public R&I). In all the scenarios a certain type of pressure transgresses the bearable boundaries forcing the institutional setting to change.

In the transformation processes that follow in each scenario opening-up/closing-down tendencies and divergent/conformist behavior respectively compete for supremacy. Once a novel stable configuration is established, it diffuses over the R&I system finally transformating the research landscape by 2030.

3.2 Comparison of scenario outcomes

The newly emerging alternative research landscapes in 2030 are characterized by a new organisation of R&I and new R&I practices fitting to the changed societies. First, we compare the societies into which the five scenarios for Research and Innovation Futures 2030 are embedded (c.f. Figure 2.1), second, the organisation of R&I (Table 3.2), and third, the R&I practices (Table 3.3).

The five futures for research and innovation are nested in five different societal futures covering Europe and the world. In the *Open Research Platform* scenario the global research landscape is open, decentralized and dispersed, networked and self-governed, in this case by open research platforms. European actors engage in these global and open research activities. In the *Knowledge Parliaments* scenario the free negotiation of knowledge claims is in line with the globally shared value of fair representation, incorporating voting and bottom-up decision-making. In the *Grand Challenges for Real* scenario Europe's separate path, routed in its citizens’ claims and its strong political position, is

7 For example, in the *Open Research Platform* scenario not only is there the tension between ongoing fragmentation of R&I that makes R&I coordination difficult, but also the tension between openness in research and exclusive exploitation of research results. In the *Knowledge Parliaments* scenario the struggle between "modern" scientific and other knowledges is accompanied by the tension between closed circle R&I programming procedures and calls for better representation of other knowledge claims.

to focus on real progress generated by collective experimentation in socio-technological laboratories, while other world regions go other ways and copy successful approaches selectively. In the *Knowledge Value Chains scenario* the globally shared purpose of research to foster innovation is realized by specialized groups of organisations building stratified knowledge value chains. The specialization and concentration at the organizational level entails interregional dependencies to cover certain research fields. In the *Researchers' Choice* scenario the multitude of autonomous researchers come forward in a world oriented at wellbeing either as slow scientists addressing local problems but being globally connected, or as science entrepreneurs adressing global markets.

The differences between the five RIF scenarios become clearly apparent at the research landscape level that is embedded into five different societal futures. Related R&I organization and practices are closely tied to the respective research landscapes.[8]

Table 3.2 (page 41) lists key characteristics of R&I in the five scenarios, namely the principal organisation of research, research programming, the production of research output and related quality aspects, as well as ownership and exploitation of research.

The scenarios differ fundamentally in the roles assigned to well-established and new organisations in the R&I landscape in 2030. The main types of organizations determine the ways how research is organized while the other actors (in particular governments) take new roles in the transformed research landscape. The *Open Research Platform* scenario and the *Knowledge Parliaments* scenario bring in completely new kinds of organization models as denoted in their titles. The established research actors (universities, RTOs, foundations etc.) relate to the novel institutions in new ways. Only in the *Knowledge Value Chains* scenario the research-performing organisations (RPOs) of today vanish and develop into Research Integrating Organisations (RIOs), Research Service Organisations (RSOs) and third-tier organisations.

In the *Grand Challenges for Real* scenario and in the *Knowledge Value Chains* scenario there is a clear rationale behind research programming: public and private actors fund research to tackle Grand Challenges and to foster economically relevant innovation respectively. In contrast, in the *Open Research Platform* scenario, in the *Knowledge Parliaments* scenario and in the *Researcher's Choice* scenario research is programmed indirectly by the cumulative impacts of the agenda-setting and funding activities of countless decentralized actors. The mechanisms of agenda-setting and funding range from rather administrative approaches in the *Grand Challenges for Real* scenario, over deliberative approaches (either open in the *Knowledge Parliaments* scenario, or closed in the *Knowledge Value Chains* scenario) to evolutionary modes in the least institutionalized scenarios *Open Research Platform* and *Researchers' Choice*.

The scenarios put emphasis on five particular knowledge production modes that require alternative definitions and assurance mechanisms of research quality. The *Open Research Platform* scenario is particularly vulnerable to fraud and attacks and thus research quality needs to be protected effectively. The *Researcher's Choice* scenario stands out in abandoning the burdensome perpetual auditing, impact assessment, and evaluation, as research quality is redefined and assured by the new peers (i.e. (local) users and virtual communities). New quality evaluators also play an important role in the other three scenarios: citizens and diverse epistemic communities in the *Knowledge*

8 That does not mean R&I organization and practices in one scenario could not be the case in another scenario as well. The relationship of the scenarios is discussed in the conclusion.

Parliaments scenario, communities of practice in the *Grand Challenges for Real* scenario, and business management evaluation organisations in the *Knowledge Value Chains* scenario.

In all five scenarios the ownership of research results and the abilities to exploit research signal the necessity to reconfigure current IPR regimes. This implies a reshuffle of business models towards alternative routes. The mechanisms how industry exploits research vary considerably, from competing to be first and best in exploitation of research in the *Open Research Platform* scenario to pre-defined exploitation routes in the *Knowledge Value Chains* scenario. In the *Knowledge Value Chains* scenario there is room for both more open and more closed R&I than today as long as it enhances economic competitiveness. In the *Knowledge Parliaments* scenario closed research and innovation around 2020 is a significant driver for the transformative change of a significant part of the R&I system. After the transformation, in 2030, R&I governed by knowledge parliaments and conventionally-governed “orthodox science” coexist.

Table 3.3 (page 42) lists the major research practices in the five scenarios, namely the predominant research types, the initiation of research, the execution of research, communication of research and transfer of knowledge.

The *Knowledge Parliaments* and the *Researchers' Choice* scenarios are marked by extremely diverse knowledge types, in the former case negotiated in Knowledge Parliaments and in the latter case expressing individual researchers’ preferences. Contrary, in the *Open Research Platform* and *Grand Challenges for Real* scenarios particular knowledge types flourish, namely open research and experimental research respectively. In the *Knowledge Value Chains* scenario the measurable research types are favoured as they can be translated into scores relevant for funding and evaluation.

Research is initiated bottom-up in the *Open Research Platform, Knowledge Parliaments, and Researchers' Choice* scenarios. The *Open Research Platform* scenario stands out with the pattern generation of new and interesting research supported by new technologies. In the *Knowledge Value Chains* scenario research is initiated with a strong impact of government calls, industry needs, and the new, large research integrating organizations (RIOs). The *Grand Challenges for Real* scenario is special as doing research by experimentation and creation of new research hypotheses and practices co-evolve, although the scope and major directions are given by long-term governmental research programs.

Hypotehtical glimpses on typical research projects in 2030 unveil new and emerging forms of co-operation enabled by next generation collaboration tools such as robotic tele-presence (*Open Research Platform*s), discursive negotiation of knowledge claims (*Knowledge Parliaments*), collective experimentation in all kind of socio-technical labs (*Grand Challenges for Real*), advanced knowledge management systems applied to research (*Knowledge Value Chains*), and the heterogeneous expressions of researcher's choices in doing research (*Researchers' Choice*).

Thorough changes in research communication appear in the *Knowledge Parliaments* scenario, in which bridging and translation of epistemic cultures drive the need for new modes of communication. In the *Open Research Platform* scenario the already well-known modes of open-access publishing replace other forms fundamentally, while in the *Researchers’ Choice* scenario online-publishing asks for voluntary contributions or generates revenues by micropayments (e.g. pay per downoad). In the *Open Research Platform*s scenario transfer of research is enabled by open

knowledge circulation. Knowledge transfer into practices is an integral part of doing research in the *Grand Challenges for Real and Knowledge Value Chains* scenarios. New organisations for knowledge transfer come into play in the *Grand Challenges for Real* and *the Researchers' Choice* scenarios, namely regional development organisations and city / municipality networks respectively.

Table 3.2: Comparison of R&I organization 2030 in the RIF-scenarios (Source: RIF)

	Open Research Platforms	Knowledge Parliaments	Grand Challenges for real	Knowledge value chains	Researchers' choice
How is research organized, and what are the main types of organizations?	ORPs organise open research in providing a platform for RPOs & funders ORPs grow and shrink, wax and wane in an evolutionary manner governments embed activities, provide infrastructure & support ORPs of public interest	knowledge parliaments summoned by interested parties from all over the world marketplaces for free negotiation of knowledge claims democratic societies regulate diverse knowledge claims in knowledge parliaments	GC-KICs oversee several socio-technical labs, each run in multi-stakeholder cooperation rise of user organizations, design entrepreneurship & developer communities EU frameworks for collective experimentation & investment / benefit sharing	value creation in KVCs with (1) integrators on top, (2) specialized service providers, (3) suppliers of fragments processes organized by business management principles national & regional governments support their organisations in KVCs	self-organised research slow science: transparent & direct collaboration with local communities science entrepreneurs: cooperation via virtual platforms governments coordinate local multistakeholder research negotiation of frameworks remains a constant challenge
How are research agendas defined, and how is research funded?	ORPs create their own agendas evolutionary funding agencies monitor ORPs to adapt funding	interested parties vote on research topics "research stock exchange" consortia seek funding for their own preferred research topics	EU tailors & funds GC-KICs, long-term planning with a strong impact on scope and directions of R&I GC-KIC agenda setting combines top-down & bottom-up processes	governments & industry fund, closed circles program research for innovation national & regional governments fund & program high-risk basic research industry conducts own basic research beyond KVCs	indirect programming by researchers, needs of local communities & global markets slow science funded by foundations & crowdfunding science entrepreneurs funded by customers, many live on pay-per-click
How is output produced, and how is quality defined and assured?	open & distributed research with supporting infrastructures in the background quality assessment by the researcher community automated reputation management & fraud detection mechanisms, protection against cyberattacks by authentification	discursive production of output by consideration of all knowledge claims quality definition & assurance by power of the arguments in fair procedures	collective experimentation, measuring of processes & impacts, and co-creation go hand in hand communities of practice and integrated impact assessment assure evidence-based progress	specific role of 3 organisation types in producing output quality is defined, rated & assured by business management principles	quality of slow science measured by contribution to wellbeing with (local) users & virtual communities perpetual auditing, impact assessment, evaluation, & NPM abandoned in science entrepreneurship, too
Who owns research results and can exploit them?	open-source licensing (if any), some ORPs restricted for security reasons industry competes to be first in exploitation	ownership of research results & exploitation are freely negotiated in fair procedures	open multi-stakeholder access to experiments & results industry gains insights into customers & collaborators, exploitation by open innovation	industry/integrators define ownership & exploitation marketing of research products to customers	ownership of research results controversial exploitation by negotiation of autonomy interests and community interests

Note: GC-KIC – Grand Challenge Knowledge and Innovation Community, KVC – Knowledge Value Chain, ORP – Open Research Platform, R&I – Research and Innovation

Table 3.3: Comparison of R&I practices 2030 in the RIF-scenarios (Source: RIF)

	Open Research Platforms	Knowledge Parliaments	Grand Challenges for real	Knowledge value chains	Researchers' choice
Research types	open research & open access	diverse epistemic cultures instead of scientific 'orthodoxy'	experimental & creative research for practical use design as leading discipline integrating other domains	system innovations for industrial value chains epistemic pragmatism but measurability counts	diversified research types expressing researchers' choices
Initiating research	pattern generation of new & interesting research supported by new technologies ideas evolve in networks	by civil society and/or research consortia via knowledge parliaments pre-selection of knowledge claims in the consortia building phase	experimentation & creation of new research hypotheses and practices co-evolve	by RIO/industry, or responding to government calls RIOs employ world class talent with competences in complex systems & creativity	slow scientists adapt research content and processes locally in cooperation with local stakeholders science entrepreneurs motivated by seeing their ideas turned into successful products, solutions & revenues
Doing research	individual researchers put findings into ORPs linking the huge & diverse inputs intense cooperation stimulated by next generation collaboration tools deeper access to ORP linked to researcher's reputation	research cultures dominated by consortia-practices common framing, but division of labor in projects intercultural communication & transdisciplinary research permeable boundaries between citizens & researchers	socio-technical experiments & co-creation lab & reality thoroughly interpenetrated testing one's behavior & being inventive boost in number & variety of inventions, filtered by integrated impact assessment	RIO: advanced knowledge & diversity management systems RSO: efficient research tools & performance enhancement 3rd Tier: delivery of missing pieces in time windows use of large automated data appraisal & processing infrastructures	heterogeneous expression of researchers' choices in doing research slow scientists do locally embedded, internationally linked research at self-determined speed & beneficial to quality of life science entrepreneurs seek to do research through highly dynamic creative processes
Communicating research & knowledge transfer	open knowledge circulation open-access publishing	science shops, new media, specialized mediators bridge & translate epistemic cultures knowledge parliament as communication arena	intra- and inter-GC-KICs open communication practical transfer integral part of doing research regional development organisations transfer results	RSOs publish but restricted by commercial exploitation interests KVCs transfer results into practice through undisclosed processes	self-determined speed & extent of publishing online-publishing asking for voluntary contributions / pay per click of download city & municipality networks transfer results

Note: GC-KIC – Grand Challenge Knowledge and Innovation Community, KVC – Knowledge Value Chain, ORP – Open Research Platform, RIO – Research Integrating Organisation, RSO – Research Service Organisation

4 Conclusion

Five distinctive scenarios for Research and Innovation Futures 2030 have been built with each one exploring tensions and dilemmas around 2020 that finally lead to a characteristic transformation of the research landscape in 2030.

The explorative scenario stages examine five key tensions and dilemmas around 2020:

1. The coordination of research and innovation is complicated by the increasing fragmentation of the research and innovation landscape and by conflicting actor strategies.
2. A worldwide struggle breaks out between scientific expert knowledge and other forms of knowledge, such as indigenous or lay knowledge, competing for credibility, legitimacy, and funding.
3. Societal unease grows about the failure of conventional research and innovation programs to address pressing societal challenges effectively.
4. Economic pressure on research-performing organisations intensifies due to requirements for fund raising and evaluation as well as stiff competition for limited research funds.
5. The attractiveness of ordinary academic careers declines because of conflicting demands on individual researchers from different directions eventually leading even to identity crisis.

Five distinctive development paths lead from the five tensions and dilemmas around 2020 to transformations of the research landscapes in 2030.

1. Open Research Platforms – Self-governance in a networked decentralized research landscape
2. Knowledge Parliaments – The free negotiation of knowledge claims
3. Grand Challenges for Real – Collective experimentation in socio-technical labs
4. Knowledge Value Chains – Research for innovation in a specialized and stratified research landscape
5. Researchers' choice - Autonomous researchers go for self-fulfillment and wellbeing

The comparison of the scenarios in the previous chapter shows the broad range of options of "future ways of doing and organizing research" that may be associated with more general societal changes.

Many of the tensions and dilemmas anticipated to be pivotal by 2020 are around already today. Increasingly they exert pressure on or undermine ongoing developments. The RIF scenarios are justified by the existence of these tensions and dilemmas, and trace the junctions / critical bifurcations that may determine the future courses of transformative change. They are meant to **stimulate reflection** on potentially radical future changes rather than to be particularly probable or desirable. The scenario development has been guided by accounting for complex realities, conflicting stakeholder interests and ambiguity of outcomes.

The **particular methodology** chosen in the RIF scenario development influences their nature substantially. While other prevailing approaches rely on two key dimensions,[9] the RIF scenarios serve to explore futures in a multi-dimensional fashion. The RIF explorative scenario methodology with its focus on tensions and dilemmas in R&I by 2020 enables the unfolding of transformative scenarios into multiple directions. The opening up and niche diversity in the RIF scenarios lead to a

[9] c.f. for example Fraunhofer (2010), ICSU (2011)

transformation of the research landscape in changing the institutional regimes, whereas other prevailing approaches do not describe such a “change in the conditions of change”.[10] However, the descriptions of the transformation processes and outcomes in the RIF scenarios are based on strong assumptions.

The five scenarios for RIF 2030 provide comprehensive images of how the world of R&I may look like in 2030, how it is embedded in society, and what a plausible pathway to get there may look like. They are not necessarily mutually exclusive, but may co-exist. **These scenarios are** devices to explore a broader perspective on the future than just analysing emerging trends and thus stimulate our thinking about the R&I futures we want to pursue, as well as about those that we may rather want to avoid, while acknowledging that they may all happen. In relation to research governance from today's point of view that could mean for example, (1) that embedded governance models for the open collaborative research landscape are designed, (2) that new fora for negotiation of knowledge claims are introduced, (3) that the potentials of specifically-designed structures for dealing with Grand Challenges by collective experimentation are systematically analysed and assessed, (4) that concentration and diversity of competences of research-performing organisations are surveyed over time, and (5) that autonomous researcher careers beyond governmental control may be considered a serious career option in the nearer future — all at the same time.

The scenarios are built around the conditions of change that are likely to give rise to tensions and dilemmas in current institutional settings of R&I. These tensions and dilemmas can coexist at the same time. While the explorative scenario stage is rather certain, the subsequent system responses and stakeholders’ reactions in the transformative scenario stage are not. The entire long-term transformation processes and related societal developments are highly uncertain. The so-called **signposts** signal directions of change in the highly unstable transformation processes. These signposts may have a decisive impact on the research landscape in 2030. For example, if in the *Researchers' Choice* scenario the world does not further develop towards wellbeing as the measure of progress but instead towards economic competition, autonomous scientists would rather go for high-risk ventures that promise large revenues than for slow science addressing local needs. Hence, signposts indicate critical bifurcations in each scenario. In reality — as opposed to the constructed world of scenarios — such signposts need not necessarily be consistent with the principal issue raised in the tension or dilemma. Some transformation processes might just not be advanced by "false signposting". For example, the world of “fair representation” featured in the *Knowledge Parliament* scenario might hardly drive the *Knowledge Value Chains* scenario and the world of “Grand Challenges priorities” featured in the *Grand Challenges for Real* scenario might hardly fuel the *Knowledge Parliament* scenario.

At the same time, in reality, tensions and dilemmas in a certain domain and the induced transformation processes may have **repercussions** in other domains. For example, the worldwide redistribution struggle between "modern" scientific and other knowledge in the *Knowledge Parliaments* scenario may not only lead to fair knowledge movements and finally knowledge parliaments, but at the same time it distracts R&I expenditure from established science which could aggravate the economic pressure on RPOs and thus fuel the transformation path in the *Knowledge Value Chains* scenario. Numerous of such repercussions could be explored.

[10] c.f. for example Fraunhofer (2010), ICSU (2011)

The scenario **dynamics may be overestimated or underestimated**. Globalisation and technical developments in R&I might be so dominant in the future that all other dynamics fall behind. Likewise, dramatically developing R&I systems of China and other non-OECD countries have the potential to set the tone on a global scale.[11] Conversely, current R&I regimes may be able to cope with aggravating tensions and dilemmas much better than described in the RIF scenarios. In fact, the mere existence of the RIF scenarios and of other anticipatory intelligence may prompt stakeholders to undertake measures to mitigate or adapt to tensions and dilemmas. For example, in the *Grand Challenges for Real* scenario, actors must not necessarily wait for a socio-ecological disaster to take them for real. They could do so because they are convinced ex ante that collective experimentation which already happens in some domains could be more effective in tackling Grand Challenges than other ways. Such intensification of tensions might loose its force so that no transformative change would need to happen. Explorative scenarios could then go on while transformative change is postponed or totally avoided.

Here, it is emphasized that tensions and dilemmas are not to be viewed as negative per se. Instead, bearing and embracing tensions and dilemmas can also open up major opportunities for renewal of the R&I system, thus providing early movers with a competitive advantage. The **European perspective** on R&I futures is brought about by the interdependence of European and global societal developments.[12] Taking into account all the monetary and non-monetary action options on R&I the room for manoeuvre of European R&I policy is limited but considerable.

The scenarios for Research and Innovation Futures 2030 all point to a further **recontextualisation of science in society**. Apart from the specific developments encapsulated in the scenarios a few universal trends can be designated: (1) clearly distinctive elements of the research and innovation system become fuzzier (e.g. researchers' and citizens' roles interfere), (2) the diversity in the research and innovation system currently increases (e.g., new actors, new roles, new rules, new constellations) but may decrease again in the long-term, and (3) all in all, the R&I activities appear to grow at various levels (e.g. number of researchers, number of publications). Among the cross-cutting key tasks for R&I governance is to direct R&I in the face of blurring boundaries, increasing variety and expansion of the research and innovation system.

11 c.f. Delvenne / Thoreau (2012)

12 The European Union's budget spending on research ranks third behind agriculture / rural development and structural policies for regional cohesion. FP 7 grants make up 8 % of public money available to researchers in the EU (EC 2012a). The largest share of the FP7 budget goes to universities and other research organisations. Roughly between a quarter and a third of participants are private sector companies (CEO 2011).

Glossary

Abbreviations

CSO	Civil Society Organisation
ERA	European Research Area
GC	Grand Challenge
ICT	Information and Communication Technology
IPR	Intellectual Property Right
KIC	Knowledge and Innovation Community
KVC	Knowledge Value Chain
NPM	New Public Management
OEM	Original Equipment Manufacturer
ORP	Open Research Platform
PPP	Public Private Partnership
R&D	Research and Development
R&I	Research and Innovation
RIF	Research and Innovation Futures
RIO	Research Integrating Organisation
RPO	Research Performing Organisation
RRI	Responsible Research and Innovation
RSO	Research Service Organisation
RTO	Research and Technology Organisation
STEEPV	Social, Technological, Economic, Environmental, Political, and (personal) Value change

Terms

Collective experimentation	society trying out things and learning from it
Explorative scenario	a scenario stage that explores emerging tensions and dilemmas in the current R&I system based on the assumption that the prevailing institutional settings will by and large remain in place
Grand Challenges (GCs)	The Lund Declaration refers to the Grand Challenges of our time as challenges on a global scale that the European Knowledge Society must tackle through the best analysis, powerful actions and increased resources.
Knowledge and Innovation Communities (KICs)	KICs link the higher education, research and business sectors to one another thereby aiming to boost innovation and entrepreneurship.
Knowledge parliament	open arena format accounting for all research interests, topics and epistemologies not adequately covered by governmental administration's research agenda setting
Knowledge value chain (KVC)	co-creation of value in research analogue to the OEM-controlled supply chain in the automotive industry in a specialized and stratified way
Open research platform (ORP)	self-governed virtual entity facilitating open collaborative Web 3.0 research
R&I practices	cover initiation (i.e. ideation, consortium building, etc.), doing (i.e. collaboration, data gathering, etc.), and communication / transfer (i.e. publishing, use of results, etc.) of R&I projects
R&I organisation	covers the formal and informal organisation and regulation of R&I (e.g., programs, quality assessment regimes, infrastructure, intellectual property rights)
Science in society	science and society coevolve in the changing historic context in which we live
Slow science	science movement that links the pleasure of doing research to a commitment to its community analogue to the slow food movement
Transformative scenario	a scenario stage that traces the junctures between the explorative scenario stage and mechanisms how the research landscape is transformed into a new one

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