

EU funding to joint priorities do exist. At the same time, there are many tensions associated with the implementation of these strategies.

A key challenge and opportunity for ERA development is its relation to and integration with the wider world. The production and composition of knowledge have become globalised. While science always has been international, the scope of actors and the need for coordination and cooperation across the globe has changed dramatically in the face of global challenges. At the same time, there is an increasing specialisation of knowledge production and exploitation. Global division of labour and connecting the global centres of excellence that have emerged is a key requirement of the future. In addition, many of the problems European societies face are either the same as for other societies (obesity, demographic change) or transnational in nature (climate change, pollution, security) while the EU is just one among many international players. The overarching challenge of decoupling economic growth from the depletion of the ecosphere and preserving natural capital demands an unprecedented alignment of efforts on a global scale.

There are a number of changes in the way research and innovation is being embedded in the societal context. Changing values and lifestyles are giving rise to new societal expectations of research and innovation. Changing economic and institutional contexts introduce new rationales into knowledge production. Established boundaries, such as basic and applied research or users and producers of innovation and knowledge, are blurring. New actors such as NGOs, citizens and user groups are increasingly playing relevant roles in the realm of research and innovation.

The need for research and innovation to address the grand challenges in realms such as health, food, security and sustainability is not only increasingly advocated but also poses new kinds of challenges. Transformative socio-technical pathways rather than isolated

key technologies need to be explored. Social innovation, service organisation and organisational innovation need to be aligned with breakthrough technological innovation. Experimental approaches are gaining relevance for successful innovation trajectories, in particular when transitions are at stake. These changes make it imperative to situate ERA in the global context.

Identifying the Grand Challenges of the Future

In order to generate custom-made strategic intelligence for the future of ERA, the starting point was, first, to identify Grand Challenges (GC) and, secondly, to do so in relation to research sectors that are relevant to the ERA. The GC were identified based on existing EU documents and discussion papers that had been published in the context of pertinent foresight and horizon scanning projects. These GC were classified into relevant research sectors, for instance health, energy, environment and civil society. This approach allowed a thematic clustering of topics, which then served as a basis for broadening the scanning of FLAs. Ten sectors and more than 760 GC in total from a stock of 71 sources were identified.

The stocktaking was designed so as to collect information that would help reach the objective of the work package, i.e. to answer questions such as,

- What Grand Challenges in the fields of economy, environment, geopolitics, society and ethics, technology and health are the documents and projects under consideration concerned with?
- Do these documents and projects represent the discourse on Grand Challenges in the European Union and in other parts of the world?
- What conclusions can we draw from these documents concerning the future governance needs of the ERA? And what do they tell us about the future requirements of RTI governance?

Sixteen Grand Challenges

The VERA team managed to identify 16 Grand Challenges from the analysis and clustering of 760 individual issues from the inventory and interviews with individual STI experts:

1. *Uncertainty is arising from a multipolar world*

Increasing polarisation and regionalisation are driving towards a multipolar world. Possible evolutions and implications of or even solutions for this multi-aspect and multi-level challenge are still hardly understood.

2. *Values and attitudes are changing globally*

Attitudes and values are changing globally; societies and particularly policy need to respond to these changes.

3. *The traditional role of the state is challenged*

A number of developments require new models of governance that go beyond the traditional model of the state.

4. *The world is becoming more interconnected and thus more vulnerable*

The more the world becomes interconnected and interdependent, the more new forms of crime and security threats are interlinked and have far-reaching consequences at all levels of society.

5. *Health concerns of an aging society are rising*

The ageing of populations has diverse implications for science, technology, economy and society that are proliferated in the context of new health risks and ineffective health systems.

6. A risk of financial system failure is emerging

In the financial sector the risk of systemic failures is increasing.

7. Current non-sustainable economic models come under scrutiny

A growing unease with the current model of economic growth calls for alternative approaches to societal progress at the macro level. At the same time, environmentally sustainable business models are required in all sectors of economic activity.

8. Migration requires responses

The challenge of migration takes many forms as a consequence of other challenges such as climate change, food and water shortages, natural disasters, pandemics etc., each of which requires a specialised and coordinated response at various levels of governance.

9. Education is struggling to cope with new demands

The education and training systems in Europe need to be modernised. A more specific demand defines the need for education systems capable of promoting sustainability, innovation and solidarity values, and new professions require highly skilled craftsmanship.

10. The health situation in deprived regions is deteriorating

Impoverished regions around the world are struggling with acute and virulent health issues.

11. Climate change is causing new diseases

New health problems are arising globally due to climate change.

12. Providing basic resources for increasing global demands becomes difficult

Without ecologically, economically and politically sustainable solutions, scarcities of basic resources may lead to extensive and serious social and political problems in some areas of the globe.

13. Material resources are becoming increasingly scarce

Demand for metals and minerals is growing dramatically, especially due to the fast growth of emerging economies and increasing strategic demand for minerals in industrialised economies.

14. Our modes of energy supply and use are threatening the survival of humankind

Adopting sustainable forms of energy production and consumption is one of the key means for mitigating climate change.

15. Transportation systems are coming under strain

Environmental and health impacts from emissions, mitigation of climate change, urbanisation, the need for traffic safety and security, and avoidance of traffic jams are among the drivers pushing towards the reinvention of mobility and full-scale transition of existing transportation systems.

16. EU competitiveness is endangered

The fragmentation of Europe, poor education and skills as well as rising costs and declining labour force participation caused by demographic change may prevent effective exploitation of Europe's research and innovation potential.

Facing the Grand Challenges to the Future of Europe Means Facing the Global Ones First

From the analysis of a broad range of sources on Grand Challenges, it becomes clear that we cannot take a European perspective only. Especially not when attempting to identify ways of dealing with the Grand Challenges, or at least some of them. The most pressing challenges are globally interconnected and require global action. Topics like *Our modes of energy supply (14)*, *Providing basic resources for increasing global demands (12)* and *The world becoming more interconnected (4)* are the ones most frequently discussed. They also show the need to accept shared responsibility on a global scale, which implies that the EU countries cannot lay back and point to other countries to take action. On the contrary, from a European perspective, European countries are among the major contributors to the drivers of the Grand Challenges and among the major countries affected as well, although

the impacts of the Grand Challenges are more widespread globally than the drivers are.

The sixteen clusters identified and discussed above also seem to be the ones that call for policy action most immediately and represent the cases where such action could make a substantial difference if planned and executed in a systemic way.

To face the Grand Challenges to the future of Europe, most of all we need to cope with the global ones. If we make a major contribution to the global ones, we will be better equipped to cope with the challenges that lie ahead for Europe.

What we as Europeans have to face is that our lifestyle and the underlying economic model must be considered the root of fundamental problems with devastating global consequences. Many studies and independent resources have pointed this out before. It is of course not only the European lifestyle but also that of all developed economies. At the same time, the global interconnectedness that seems to make this lifestyle transferable to emerging, lagging and, in the long term, even to undeveloped econ-

omies also makes societies vulnerable to shocks in many respects.

Facing the Grand Challenges means to introduce fundamental changes in many areas of our lives and activities, thereby affecting global liaisons as well. Even if radical changes are unrealistic, the changes required in tackling the Grand Challenges will be felt by every European citizen. Policy-makers are in a crucial role as these changes will not occur without fundamental and coordinated policy measures in almost every policy area.

Furthermore, it becomes clear that the scope of these Grand Challenges is in essence societal. We need to take this into account when we talk about policy action, for example in the area of research, technology and innovation policy – in the respective work packages of the VERA project and beyond. We especially need to consider what the impact of that societal scope is with regard to the systemic character of handling the Grand Challenges.

Text Analysis and Discussion with “ERA Thinkers”

The second set of tasks performed was to synthesise the existing insights on trends, drivers and key dimensions of change in European RTDI governance. A computer-assisted analysis helped to characterise the body of discourse on ERA in a systematic and quantitative manner. The analysis of text data on ERA was expected to allow interpretations and descriptions of the attitudes, structures, values and norms that currently dominate STI governance. In view of the large quantities of data in textual form, text analysis provided an important means of discovering obscured meanings and unveiling hidden relationships. The computer-assisted analysis took as a point of reference a pre-understanding of ERA constituencies gained through literature review. Following the digitisation of the entire corpus, linguistic analysis software was used for cleaning and formatting, unitising and indexing. The development of categories and dictionaries, as well meaningful associations, relied on qualitative analysis techniques.

Quantitative text-analysis software allowed to produce an aggregation of unit-level coding. Statistical and network analysis software was used to highlight fre-

quencies, trends, comparisons, networks and maps of relevant factors influencing STI governance.

Subsequent interviews with ERA “thinkers” served to obtain additional types of information (i.e. narratives, accounts, fronts, stories and myths).

Relevant factors identified by means of discourse and interview analysis provided the basis for a so-called key-factor workshop with key stakeholders. The insights on potential key factors were synthesised into a background document.

Based on these insights, VERA developed scenarios on the evolution of the European Research Area. VERA’s uniqueness is grounded in the systematic knowledge base it creates, for example, by stocktaking exercises such as the one on Grand Challenges described above. They are publicly accessible and intended to be used widely. At the same time, the results of these exercises feed the scenario process, the subsequent assessment of the scenarios, and the exploration of strategic options. Another distinct feature of VERA is that it pays particular attention to the assessment and policy implications of the scenarios, which will help to make scenario results useful for policy-making and thinking about the future of ERA.

Sources and References

References

The Lund Declaration (incl. its addendum), July 2009; available for download at http://www.vr.se/download/18.7dac901212646d84fd38000336/Lund_Declaration.pdf

Links to further results of the VERA project at <http://www.eravisions.eu>

The inventory contains 726 individual Grand Challenges named by the 67 screened FLAs. It has been submitted in an independent report and can be downloaded at <http://vera.dev.zsi.at/stocktaking/list>

About the EFP: Policy professionals dealing with RTD, innovation and economic development increasingly recognize a need to base decisions on broadly based participative processes of deliberation and consultation with stakeholders. Among the most important tools they apply are foresight and forward looking studies. The EFP supports policy professionals by monitoring and analyzing foresight activities and forward looking studies in the European Union, its neighbours and the world. The EFP helps those involved in policy development to stay up to date on current practice in foresight and forward looking studies. It helps them to tap into a network of know-how and experience on issues related to the day-to-day design, management and execution of foresight and foresight related processes.