

Background paper to the Lund declaration 2015 – draft version

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Lund declaration

The 2009 Lund declaration concluded that European research must focus on the Grand Challenges of our time. To respond effectively, the European Research area must develop processes for identifying and tackling grand challenges and move away from thematic approaches. Responses to grand challenges should take the form of broad areas of issue-oriented research in relevant fields. The declaration further called for European cooperation built on transparency and trust, involving stakeholders from both public and private sectors. It was a new ambitious agenda focused to tackle the grand challenges, as a contrast to traditional thematic approaches in research and innovation. A number of important prerequisites were identified: the need to strengthen frontier research initiated by the research community itself, the need for Europe to take the lead in the development of enabling technologies, the importance of bringing together supply and demand-side measures to support both business development and public policy goals. Furthermore the declaration emphasized the importance of modernising universities, research institutions and the cooperation among them in order to create excellence and well networked knowledge institutions. The creation and maintenance of world class research infrastructures in Europe was emphasised as well as necessary changes in the Communities’ financial regulation and rules in order to form a risk tolerant and trust-based approach in research funding.

The Lund declaration 2009 told Europe what we must focus on – Grand Challenges of our time and ways forward. Lund declaration 2015 continues this call by focusing on issues how to get there. We now need to take further steps to effectively find and implement solutions to global challenges for the benefit of citizens, and the advancement of a sustainable and globally competitive society as a whole. We need to take next steps to also develop the main prerequisites identified above, in order to create a European research and innovation ecosystem capable to produce and implement real solutions, e.g. a system that can make visible changes.

The declaration shaped six years ago is still as urgent today. The world faces a range of societal challenges, which require joint efforts of many countries, sectors and stakeholders to be solved. Refugee flows, climate threats, economic crisis, pandemics, lack of access to education and health put increased pressure on society to find solutions that can be applied in political decisions, smart innovation, medicines and new technologies but also incitements for a change of lifestyles. The magnitude of societal challenges, is of the kind that no individual researcher, research discipline, nation or industry alone can develop solutions on their own. Many of the major challenges confronting the world have been identified early on, while they are still to be solved and some of the challenges have even been intensified. Looking at the current trends, new ones are also arising. To conclude, there is no time for neglecting nor postponing a continuously strong response to tackle the challenges. In this sense, research and innovation plays a fundamental role and investments for these are vital.

The urgency of the societal challenges of 2015 call for a the long-term perspective where the importance of research and innovation cannot be overstated for improving European citizens living conditions, for sustainability in society and for economic reasons. The urgent call for a new approach, where the scientific community, industry political decision makers and stakeholders, such as civil society, commonly engage in the process of ensuring concrete improvements for society, thus demonstrating that research and innovation addressing societal challenges can make difference. In the present situation we need to make much more visible that R&I investments deliver results for the benefit of our industry and citizens. Strong research and innovation investments is part of the package safeguarding the European framework for future growth and jobs. The impact of these investments can be further increased by better circulation of and access to (scientific) knowledge. Science should be open with an open access to research publications and research data as an essential element.

The transition to a more sustainable society need all kinds of research and collaboration between different actors. Research as a whole provides the basis for society to deal with complex problems and to take advantage of unforeseen breakthroughs but also to discover new challenges. In the longer term tomorrow's cutting edge knowledge may emerge from the unexpected and researcher-initiated frontier research.

The Lund declaration 2015 stands firm on the statements in the first declaration. It continues on its track but takes its starting point in the implementation phase. For years to come Europe needs to increase the effectiveness and make better use of results from research and innovation. For that we need new approaches and ways to take joint action. The Lund declaration 2015 points out four key policy areas and next steps needed for investments in research and innovation to have full effect in society. The four keys concern alignment, global mobilisation, frontier research and impact. The perspective is broad and includes different forms of collaboration. It provides recommendations for the next steps to align Member States and European institutions in further developing the European research and innovation system, with the target to give impact and utilization of research results.

This background paper is based on dialogues with stakeholders and forms the basis for a declaration to be presented in Lund in December 2015. The Lund declaration 2015 is a policy document. How the targets and next steps are to be realized in activities is a common task for member countries, European Commission, Associated countries, stakeholder organizations, regions and the academia in the coming years.

State of play and progress since 2009

There is one questions in focus when we look back at the last six years since the first Lund declaration was adopted: "Have we managed to change the way research is funded and conducted at the EU and Member State level?"

One can rightly say that the Lund Declaration had a real impact on key features of European research and innovation policies, as well as in national research and innovation strategies. Since 2009 the European research and innovation landscape has made a clear shift towards a challenge-based approach. From "Grand challenges of our time" it changed to "societal challenges" and the performance of the transnational cooperation was developed both with programming initiatives and the broader European Research Area. Collaboration across borders was facilitated even if clear obstacles still remain. It includes a higher degree of interdisciplinary research, higher involvement of societal stakeholders, a higher focus on societal and social innovation and a quest for research impact on society as a whole. The shift can be observed in national programs, in the Joint programming initiatives set up by the member states, and in the current framework program, Horizon 2020.

However, to more precisely analyse the progress in tackling societal challenges during the last 6 years is more difficult as there are no systematic monitoring and no indicators yet. Current studies are based on facts and figures from the entire research and education systems regarding European Research Area (ERA) and member countries statements in surveys. The report in this section of the six years of progress is mainly based on two studies from the European Commission: *Analysis of the state of play of the European Research Area in Member States and Associated Countries: focus on priority areas Final report, 2014* and *European Research Area Facts*

and Figures shows 2014 gives the following picture of the state of play and progress since 2009. We focus on progresses regarding alignment, global cooperation, investments in frontier research and knowledge transfer and impact.

Joint Programming is the most obvious developed form of alignment. JPI has stimulated Member States to jointly tackle societal challenges. The ten established JPIs are scientifically broad and often multidisciplinary and have constructed common research agendas and open calls. JPIs have facilitated the interconnection of research and innovation. Member States have embraced the concept and committed themselves to large investments. Within the ten JPIs real efforts have been made to align European and national instruments, strategies and programmes.

According to the studies mentioned above transnational cooperation at programme level between Member States has increased and forms part of the national strategies of 16 Member States. Joint Programming Initiatives (JPIs) are increasingly helping to align national programmes and activities to common agendas at EU level addressing societal challenges. Several Member States have started to develop national action plans, roadmaps and strategies in the domain of the JPIs they participate in, with a view to strengthening their commitment to the Strategic Research Agendas of JPIs.

However, there are still big differences between Member States in the way research funding is being allocated. While competitive project-based funding occurs in all Member States, the extent of it varies significantly between countries. In 2010 on average, about 3.8 % of EU Member States' R & D budget was directed to 'transnationally coordinated research' for the 21 EU Member States providing these data. The share of the total R & D budget (GBAORD) that was used to fund 'transnationally coordinated research' ranges from 0.27 % in Romania to 4.76 % in Austria, with an EU aggregate of 3.79 % (based on the data for 21 Member States).

Most JPIs have now adopted joint strategic research agendas setting their priorities and some have multi-annual implementation plans. In total their joint activities up to the end of 2013 amounted to more than 20 joint calls and joint actions for a total of more than EUR 200 million. However, this amount is still of a limited size considering that at European level with the exclusion of the Framework programme and the European Funding Agency funding, less than 1 % of national public R&D funding is spent on transnational research.

The Framework Programme Horizon 2020 is a major facilitator of cross-border research based on excellence.

The ERA-NET scheme provide financial support from the framework programme to transnational cooperation by co-funding calls and other joint activities related to the coordination of national/regional R&D programmes with almost EUR 400-500 million per year.

One observation is that the instruments in some of the partnership programmes where the Member States and the EU Commission jointly support challenge driven research activities are fragmented, which something can hamper and slow down development and progress of the programmes. These supporting instruments can be streamlined and more strategically focused on tackling societal challenges to support the member states' investments in research and innovation.

International collaboration within and beyond Europe is emphasized throughout the European Research Area. Integrating international cooperation into the first Horizon 2020 work programmes, aimed at strengthening communication on the openness of Horizon 2020 to the participation of international partners and enhancing cooperation with the external funding instruments and overall EU external policies have been major points of attention during the two years of implementation of the Commission's new international cooperation strategy.

However, according to the ERA survey 2014, funders in more than half of Member States allocate an average of 0.7 % of their budget to collaboration programmes with third countries. Among the 19 funders responding to the survey six indicate that they fund a higher share than the EU average (more than 2.4 % of their funding). Among them, five countries declare they have policy support for international cooperation but there is no budget allocated to these activities.

A number of countries have more general programmes supporting international research collaborations in which the focus of financial support seems to be more on providing funding for foreign research visits or

stimulating doctoral candidates to pursue studies in other countries than on providing specific access to certain research infrastructures.

Project-based funding is the most important way to induce competition in research as a way to support excellence in research. The Commission could identify support to the implementation of project-based funding in the national Research and innovation strategies in 21 Member States. According to the results of the ERA survey 2014 project-based funding is allocated by funders in all Member States, with an average of 64 % of their R&D funding allocated using this modality.

In terms of public funding for research measured through the Global Budget Appropriations or Outlays on Research and Development (GBAORD), big differences remain. The differences are partly explained by differences in national income and purchasing power. However, it should be noted that GBAORD does not consider other efforts undertaken by national authorities in support of R&D such as tax incentives, credits, etc. whose importance has risen in the past few years, but for which limited information is available.

The importance of excellent research infrastructures for achieving excellent research is widely acknowledged by countries and is represented in national roadmaps on research infrastructures. However, doubts were raised regarding whether some national roadmaps can really be considered roadmaps, as no specific plans were incorporated on how to achieve the targets set and coherent harmonised approaches are missing. Specific measures to support cross-border access to research infrastructures, either financially or by providing information or establishing common rules for access and use are only provided by half of the countries under consideration.

For the development and implementation of research infrastructures, 22 Member States have adopted National Research Infrastructure Roadmaps. Five of them have been updated since 2013. However, national roadmaps do not consistently indicate the links with the European 6 COM(2014) 339 final 7 Facts and Figures report, Section 'Competition for public funding' 8 Furthermore, almost 70% of institutions represented in the 2014 ERA Survey belong to organisations whose funding is subject to an institutional assessment Strategy Forum on Research Infrastructures (ESFRI) Roadmap and the financial commitments to the development of Research Infrastructures identified by ESFRI and other world-class Research Infrastructures.

Knowledge transfer between the public and private sectors was identified as a shared priority in all countries. Moreover, the high level of measures and activities shows that public authorities around Europe are actively engaged in increasing the contribution of public research to their competitiveness. A huge diversity of measures was detected, even on the same issue in a single country. All kinds of instruments are used, from legal measures to financial support and coordination activities. In this context a key issue is the measure of the efficiency of these activities, in order to identify the most appropriate ones and analyse their replicability from one country to another. However, there are currently no robust instruments, other than competitiveness indicators, to measure the efficiency of these actions. Such measurements could be undertaken through a case-by-case analysis taking into account the socioeconomic specificities of the countries.

Whilst open access to publications is becoming well established and well known, this is not to the same extent the case for open access to data and for the deployment of e-infrastructure. Understanding remains limited due to the lack of robust sources. The investigation highlighted that the first activities in these fields come from stakeholders acting as precursors. Public authorities often play a key role in the development due to the need for infrastructures and management, and due to the higher costs. This involvement can be as a main player or as support for (a group of) stakeholders. Important differences in activities and means were identified between countries. Some are developing ambitious infrastructures and instruments (acting as precursor states/regions), whereas no or nearly no actions were identified in several countries.

We acknowledge the progress made but also note that efforts remain. More than six years after the first Lund conference, Europe still recovers from the earlier economic crisis. Public investments in research and innovation have rightly been central in recovery plans in some countries. European joint investments in research and innovation are also at historical levels, although still well below the ambitions in the Europe 2020 strategy. Even though the investments have contributed to the important revival of European economy, difficulties remain. Employment rates are below post-crisis level and private investments in research and

innovation are on the decline in many countries. Hence, it is important to step up our efforts in both making investments in research and innovation and to see to that research and innovations are more effectively transformed into real impact for the whole society. The challenge approach itself serves as an important driver for this. Solutions to grand challenges will be able to increase life quality and give us better societies. But they can also have an important role in strengthening European competitiveness and growth. By focusing on bringing forward solutions to grand challenges of European and global interest, the actual solutions can have a high potential for global demand, and increase European exports, and create jobs and growth.

The shift to a challenge-driven approach has only begun, and consequently we need to develop the approach further in order to even more effectively than today tackle the challenges we know, be prepared for arising challenges and find more effective ways for opening society to take advantage of research and innovation. Europe and its Member States need to continue to strengthen Research and Innovation to build on robust systems that is ready to identify and tackle current and new societal challenges through global collaboration with the aim to achieve efficient Societal Impact.

A challenge-based approach and its prerequisites

The picture of the progress made since the Lund declaration 2009 in the previous section shows that there is a great need to continue to develop the European research and innovation system in order to create real impact when addressing societal challenges. Europe need to change the way we work together when focusing on our common societal challenges. The research and innovation system must be further elaborated in a challenge-based approach that bring together resources and knowledge across different fields, technologies and disciplines to form a working force in various measures, activities and projects with the aim to solve societal challenges. Together research, innovation and the surrounding society must constitute a robust eco-system that influence each other's environments and conditions and depend on each other with the aim to find solutions to social problems. This will cover common measures from research to market with a focus on innovation-related activities, pooling resources, absorbing capacities, skills and competences in research and innovation processes.

This inclusive working method calls for researchers, policy makers and other actors to cooperate cross border - with the surrounding society. This means that engineers, physicians and scientists collaborate with humanists and social scientists in different configurations and with actors and stakeholders in politics, government, regions, business, industry and civil society. The goal is to create a basis for further decision making and/or innovations or social innovations. It requires curiosity and diverse lighting of the problems and that each actor move beyond their own profession without sacrificing their specific methods, theories or professional identity. Just as important as developing the collaboration as ways to reach and implement real solutions to the challenges is to enhance quality and effectiveness in the prerequisites identified already in the 2009 Lund declaration. Europe needs to strengthen frontier research initiated by the research community itself, develop enabling technologies, modernise universities, research institutions and the cooperation among them, create and maintain world class research infrastructures as well as take necessary changes in the Communities' financial regulation and rules in order to form a risk tolerant and trust-based approach in research funding.

One important cornerstone in a robust eco-system is the citizens' trust. Research and innovation must consider the principles on which the European Union is founded, i.e. the respect of human dignity, freedom, democracy, equality, the rule of law and the respect of human rights, including the rights of persons belonging to minorities. It must build on the RRI process (Responsible Research and Innovation) which requires that all stakeholders including civil society are responsive to each other and take shared responsibility for the processes and outcomes of research and innovation.

In order for the challenge based approach to have real impact Europe needs to raise the level of quality and effectiveness in four key areas. These areas are alignment, global mobilisation, frontier research and impact. These areas need to be further developed and elaborated by the Member States, Associated countries, the European Commission, the academic community, the industry, the civil society and the funding agencies.

Key 1: Alignment beyond programming

In order to tackle societal challenges, the 2009 Lund Declaration urged for a move away from the thematic approach of FP7 to a challenge based structure. In parallel, a process to align member state's funding of research and innovation systems in key challenge areas was initiated through the Joint Programming Initiatives. The rationale behind the efforts to use the resources to address societal challenges in Europe in a more concerted way are clear. First of all the urgency and complexity of the societal challenges are so great that the most knowledgeable persons and organizations must contribute regardless of nationality. Secondly, the level of investments needed to address most of the challenges of today are too big for one country to manage. Thirdly, we must make sure that the resources available are used in the most efficient way, avoiding unnecessary overlaps, and exploiting synergies. The dimension of Europe requires that it taps on all its potential and not only on part of it. All of these arguments call for a greater alignment of European investments in research and innovation on regional, national and EU level.

Over the last 10 years several efforts have been made to move towards interoperability across countries, instruments and sectors. The Joint Programming Initiative is perhaps the most well-known measure with 10 initiatives established in key areas. Article 185 is another example where member states and the Commission have joined forces to provide funding in specific fields. Yet another, however not with an exclusive focus on societal challenges, is the ERA-net Cofund. These initiatives have been taken in order to fulfil the ERA objective *"Improving alignment within and across the Joint Programming Process and the resulting initiatives (e.g. Joint Programming Initiatives (JPIs)) and speeding up their implementation."* The work so far has provided us with valuable experiences. The obstacles in transnational collaboration are many. Some have been solved while others remain unsolved.

The research and innovation funding landscape in Europe is very diverse and in general a smaller share of the public funding is concerted European programmes. Hence, in order to move forward we need to learn from valuable experiences of the last ten years, and make use of all the important work that has been put into developing compatible frameworks and develop guidelines for transnational program collaboration. However we need to go beyond this common program approach, and view alignment broader. A broadened scope of alignment will also include institutional funding and initiatives such as the SET-plan. As we move forward, we also need to be less formalistic and move away from fixed regulations and budget requirements. Instead we must develop processes for *smart alignment* based on a continuous exchange of information, discussion and joint strategic thinking. In this way we open up for regional, national and EU-level stakeholders to own their prioritization processes, and at the same time make sure that we can think together in order to develop a more compatible system. The goals of smart alignment are to gather strength, increase readiness, avoid unnecessary overlaps, exploit synergies, and address key societal challenges. Deliverables could include joint strategic research and innovation agendas in specific areas, development of common infrastructures, synergies between EU-programs, opening up of national programs for transnational collaboration, and, of course, joint programs as an integrated part of future ERA road map exercises.

Smart alignment can boost contingency and sharpen preparedness both on national and EU level. The reciprocal interaction, clear roles for stakeholders and synergies to be achieved can be clarified and elaborated for each activity or project. In this broad perspective of alignment focus is on the responsibility of each stakeholder, definition of their tasks, operations and the conditions, under which they interoperate with others. This will allow for better collaboration and division of tasks and give better prerequisites for implementation of research results and use of new knowledge. It will allow for better preparedness to act swiftly in a rapidly changing world and in response to new emerging challenges, as well as, secure impact from investments made to support research and innovation. It also helps to clarify to what extent and how the alignment within ERA can be designed. In developing systems to foster alignment, the ongoing efforts to design national smart specialisation strategies should also be considered. Particularly in cases where national resources are constrained, mechanisms for linking smart specialisation and societal challenge-based approaches need to be addressed, ensuring that these are mutually reinforcing.

In the view of smart alignment national priorities need to go beyond conventional national thinking taking into account challenges at European and global level. At national level this would entail not only ministries which traditionally are responsible for research and innovation but also other ministries, for specific challenges. New Member States or Member States lagging behind adequate transnational cooperation on societal challenges, should be assisted with capacity building exercises. Improved framework conditions for research and innovation (which is linked to the broader discussion on better regulation) are essential for optimally facilitating research and innovation.

The high level group for joint programming (*Groupe Programmation Conjointe, GPC*), have defined alignment as follows (2014): *Alignment is the strategic approach taken by Member States' to modify their national programmes, priorities or activities as a consequence of the adoption of joint research priorities in the context of Joint Programming with a view to implement changes to improve efficiency of investment in research at the level of Member States and ERA.* With this definition in mind it becomes evident that there are still barriers to break down in order to improve conditions for transnational research collaboration, and to move towards more aligned research systems.

To be both efficient and up-to-date it is of great importance that smart alignment processes can be established without the burden of heavy bureaucracy and technical/legal/instrumental obstacles. Member States, associated countries and other international partners should be supported in their alignment of national research systems to achieve better interoperability and more strength. A generically designed framework of conditions can serve as a platform for collaboration projects of any kind including projects tackling newly identified societal challenges.

The next steps for a broader smart alignment processes could be taken care of within the existing ERA landscape with the aim of simplifying and achieving a more efficient collaboration. Here the ERA-related groups have a strong role in advising the Council together with relevant stakeholders taking into account the implementation of the ERA Roadmap. Research funding organisations and institutes, the academia and individual researchers, industry and stakeholder organisations have to be incentivised to be engaged in the process.

Key 2: Global mobilisation

Europe needs to increase its global research and innovation cooperation when addressing societal challenges. Global collaboration is a necessary element in the challenge based approach. There are a number of strong arguments for that.

Societal challenges of today are truly global and crosses every boarder. To be addressed it requires global solutions, and consequently, participation from global partners. Many countries outside Europe are increasingly investing in research and innovation. In terms of investments in research and innovation, Europe is lagging behind for example North America and rapidly developing Asian and African countries. These countries are also affected by climate change, migration, terrorism, epidemics and economic crises. Today new exciting research and cutting edge innovations have potential to emerge anywhere and everywhere. Often there are different mindsets about how complex problems and systemic issues can be solved. True global research and innovation that bridges borders of any kind have potential to give new perspectives and approaches and must be taken as an asset.

Collaboration with internationally strong research is key to a strong science base in the future. Collaboration can be used to attract international top talents for a career in Europe, both in academia and the business sector. Opening up ERA and European research and innovation programmes for collaboration outside Europe to a greater extent, also reflects trends in innovation activities of leading companies, were R&D is performed in many different parts of the world.

Since a long time, researchers are collaborating with others worldwide on a bottom-up basis. Constraining and not operable rules is still putting obstacles for international collaborations and the mobility of European researchers. Global mobilisation of European researchers depend on the European framework which has to be compatible with the framework conditions in the rest of the world.

With a changing research and innovation landscape, excellence and key competence is to be found around the globe. Going forward, we need to move beyond the traditional collaboration patterns of the European research and innovation communities, and actively seek to reinvigorate our networks with partners also from emerging knowledge nations. Today most researchers and companies based in Europe want to compete in the world and to achieve this is often through global cooperation, exploiting the advantages of open science and open innovation. In short, a more pro-active approach through which global research cooperation can be facilitated, developed and exploited. This is valid at European level as well as at national level. In this respect the top-priority identified for global cooperation in the ERA-roadmap is essential: Develop and implement appropriate joint strategic approaches and actions for international STI cooperation on the basis of Member States' national priorities. Thus Europe needs to take an initiative to open research and innovation collaboration with the world, to become an active and important global player.

Key 3: Frontier research for a strengthened European knowledge base

The challenge based approach is dependent on research excellence and frontier research. Hence Europe must maintain and raise the level of research excellence, ensure world-class research and secure long-term competitiveness in Europe's science base by improving researchers working conditions, collaboration and possibilities for mobility. Quality must be ensured throughout the whole Europe, by endorsing the best ideas, by supporting young talents in the education system, providing researchers with access to priority research infrastructure, and making all Europe an attractive location for the world's best researchers – both women and men. Equally important is to increase the requirements of research integrity to curb research fraud and misconduct to secure the independence of research. The responsibility for a frontier research in world class lays on the academic systems in each country.

Frontier research needs to be further strengthened and at the same time be opened up for collaboration and use. Excellence, research integrity, openness and collaboration are cornerstones in the research and innovation system. Thus it is of high importance to keep large funding on fundamental, free research as this basic research will always pour new knowledge to the whole eco system, even in unpredictable ways. On the one hand, frontier research and technology are of critical importance to our long term economic and social welfare. On the other hand, research that pushes and transcends the borders of our understanding is also a risky venture into new and emerging research areas. It is therefore of central importance for the findings that investments in frontier research will be made in a long term perspective, and that they are not limited to areas of clear strategic importance.

The most fortunate investment in the research system is the regrowth of young people into academic programs on societal challenges. Europe needs to invest more in the younger generation and enable students to address societal challenges and to be part of the solutions. Young student's talent and ability to think and act in new and different ways must be utilized.. The next generations of students in academic studies are open for collaborations to bridge barriers. As a consequence the academic system need to be modernized, a measure already mentioned in the Lund declaration 2009. In the long term perspective Europe also needs to raise the competence and skills in addressing societal challenges It could be done in university programs that give students the opportunity to engage in in research or design projects in societal challenge areas. With a focus on higher education and the younger generations it is of great importance to ensure continued large investments on the whole in research and education, including fundamental and frontier research, which is a key for the development of our knowledge-based society.

Within ERA important work has been done to increase interoperability and interconnectedness of instruments for supporting collaboration. Next steps should open up for diversity through involvement of actors in a broader global context, for more effective implementation and capitalisation of research, but also for societal impact. Solving societal challenges will also require researchers to work in new ways and networks in terms of involving different kinds of actors such as end users and in particular the way to interact/cooperate with each other. In this new research landscape frontier research has a crucial role. Free frontier research constitutes the basis for the development of society and democratic structures. Research often study and aim to solve the

current problems and needs of our society. It must be stressed that research that looks beyond the issues and knowledge of today is just as important.

When addressing societal challenges there is also need for seamless cooperation across disciplines. Multidisciplinary research improves the prospects for finding solutions to global problems and contributes to the strengthening and broadening of individual research areas. Social science and humanities plays a central role in developing multidisciplinary. In the context of societal challenges it is often a necessary component. There are two reasons for that: the world urgently need more knowledge in the social sciences and humanities to tackle matters as terrorism, migration, economic crises etc. We also need more research in social sciences and humanities for learning and communication. The grand societal challenges the world faces today often have deep social dimensions. The perspectives of economists, geographers, sociologists, demographers and anthropologists – just to mention a few - is crucial for the analysis of how the world functions, and how individuals interact with their surroundings. They provide foundations for evidence-based decision-making in all fields, from reducing poverty and improving education to urban migration, gender equality, and economic growth. Multidisciplinary research must therefore be given a strong position in the challenge based eco-system. It should not only target the academic world but strive to have social, economic, environmental and cultural impact.

At European level, the European Research Council (ERC) has an important role of maintaining excellence in research by supporting highest quality research, competitive funding and to support frontier research across all fields. It allows researchers to identify new opportunities and directions. ERC should also take increasing responsibility for building a new generation of top researchers and for their circulation all over Europe.

Investments in and coordination of research infrastructure across Europe has been essential in generating European research of highest quality. In addition, large infrastructures form important global hubs for research collaborations as they attract excellent researchers from across the globe to Europe. Continued investments in research infrastructures and continued efforts towards an aligned roadmap of infrastructures across Europe are necessary prerequisites for raising research and innovation excellence in Europe.

Key 4: Impact for visible change

A major task in the coming years is to ensure that investments in knowledge creation result in innovations and contribute to real change in the society. The Europe 2020 Strategy stipulated concrete actions at EU and national levels: smart growth (fostering knowledge, innovation, education and digital society), sustainable growth (making our production more resource efficient while boosting our competitiveness) and inclusive growth (raising participation in the labour market, the acquisition of skills and the fight against poverty

The 2009 Lund Declaration called for addressing societal challenges, and for real impact. In this spirit the ability and effectiveness of European research and innovation systems needs to be strengthened. The strive for impact in the challenge based approach can be accelerated by more effectively utilising high level of knowledge and research, matching different actors and stakeholder groups, stimulating demand side actions and making sure that the solutions are of importance for European as well as for global societies. Implemented, solutions will increase European innovation performance and impact.

Impact can be in the form of a new law, policy or standard, new ways of working in the public sector or business, new materials or products, or new behaviours and lifestyles and many other things. Virtually all types of research can have importance regardless of discipline and area. It is evident that it normally takes time before impact and implementation from research and development follow. It is also clear that such impact requires that involvement of many and various actors. In addition there are barriers of different kind, for example structural, organisational and cultural hinders within the academia, as well as barriers between sectors. Effective knowledge transfer to and from different stakeholders is important, but not always easy to achieve. For this, the challenge based approach itself can serve as an instrument for knowledge exchange, since actors collaborate towards a common goal.

Challenge-driven research need to be open to the integration of citizens' interests and values into science, technology, research and innovation issues, policies and activities. Integration is likely to increase the quality, relevance, social acceptability and sustainability of research and innovation outcomes in various fields of activity from social innovation to nanotechnology. Open innovation processes must be encouraged and supported. Open innovation processes seek to combine required skills and experiences, but we need to further develop methods to do this.

The university sector has an important role in knowledge creation, but European universities still seem to have a significant degree of untapped potential in enabling this knowledge to come to use in society and industry. For instance the US and Japan are by tradition strong in this field, and a number of emerging countries are now rapidly developing their capacity.

We need to broadly modernise our European universities to increase their performance in knowledge exchange and open innovation. The universities' task to collaborate with the surrounding society, i.e. research institutes, industry and the public sector, is in general under-attended today, and needs leveraging and appropriate stimulation. This could be achieved by putting strong incentives in place for increasing the universities' own responsibility in collaboration and engagement in open innovation. Competitive allocation of basic funding, where part of the funding is coupled to the achievements in the collaboration task, could serve as a strong such incentive. This way the university sector's important role in knowledge exchange and impact could be strengthened, also without necessarily requiring additional funding.

For bringing forward solutions to grand challenges and creating impact, innovative industry can often have an important role, in their continuous efforts in surpassing competitors, stepping up in value chains, and increasing growth. Also industrially oriented research institutes can have an important role in challenge-based approaches, in their understanding of societal and industrial needs, as well as university activities, and their ability to co-create with different sectors.

Further, for bringing forward solutions, demand is of obvious importance. By better coupling supply and demand side actions, by in particular stepping up demand side actions, innovative solutions can be stimulated. Such demand side actions could for instance be prizes, innovation procurement or lead market initiatives.

Public authorities can use procurement of innovative solutions to bring forward new solutions to their needs, which then may be applicable also for other actors. The present framework program has introduced valuable novelties for supporting development of pre-commercial procurement and public procurement of innovative solutions. These instruments could be further developed in order to create wider impact when used to address societal challenges.

Going forward, the potential of public procurements as a way to stimulate innovation should be utilised in a more strategic way within the EU-system. Finding appropriate incentives and instruments can increase the number of new solutions introduced in society, and enhance long term public sector efficiency.

For broad implementation of a challenge based approach, actions also from policy makers in areas outside of the traditional research and innovation field would be of high value. This would require that the current approach in strategic research and innovation should be complemented by an openness to include more actors in developing the solutions to the societal challenges, in all stages, from problem formulation to implementation.

Monitoring is of importance for long term ability to increase impact and efficiency of bringing forward solutions to grand challenges. We therefore need to find appropriate measures to monitor this, preferably as a part of existing processes and structures.

Ministers could recall the existing evidence, and commit (in partnership with the Commission and in close cooperation with OECD) to definitely promote the measurement of the impact of R&I, taking advantage of the benefits of new technologies (big data) and access to new sources of information and data. As an example of the caveats that apply concerning this topic we may mention just a few. There is not yet a commonly agreed set of indicators to measure R&I oriented to societal challenges. Their multidisciplinary nature has been a

major handicap to establish it. We cannot either adequately measure the advance in the ERA roadmap priorities. This concern has been around for several years, but has not yet been translated into real action. This will not be trivial, it will require a complex process of defining, reviewing, and validating indicators, producing new statistics, etc. A political impulse at the highest level could be key. This work has to be part of a global endeavor, involving all the relevant European and international institutions in the field.

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