THE EUROPEAN ASSOCIATION OF
RESEARCH & TECHNOLOGY ORGANISATIONS

Getting the Balance Right in Horizon 2020

Optimising Public Research Investment for Maximum Innovation Impact

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Research and Technology Organizations

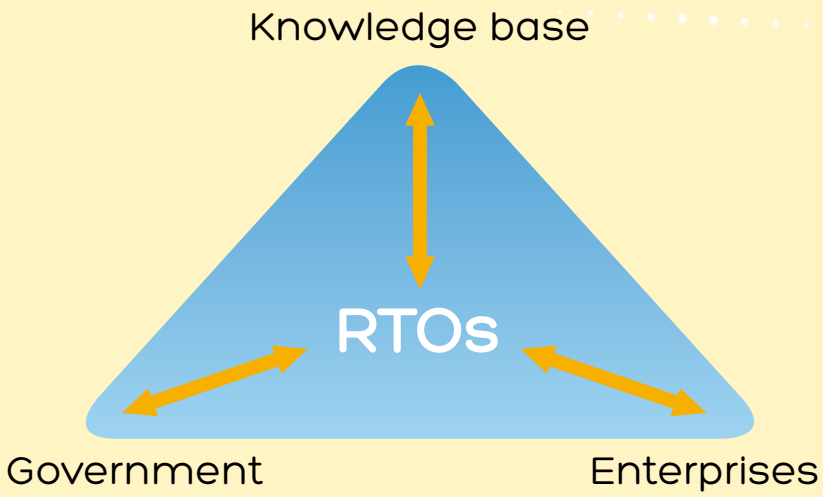
Europe's Research and Technology Organizations (RTOs) have been making a major contribution to innovation excellence, economic competitiveness and social progress across Europe for 60 years or more.

They produce ground-breaking research and enable high-impact innovations to help governments tackle societal grand challenges and, more generally, to improve quality of life for all.

Their research resources and technology commercialization knowhow each year help well over 100,000 companies, from SMEs to multinationals, to go beyond their internal technological limits to produce world-beating innovations.

The combined annual turnover of Europe's RTO sector has been estimated at about €23 billion and their total economic impact at up to €100 billion[1].

Against the current backdrop of fiscal austerity, urgent grand challenges and ERA objectives, European and national policy makers want real innovation impact. That is what RTOs deliver and will deliver in Horizon 2020.



[1] Report by Technopolis Group on the Impacts of European RTOs: A Study of Social and Economic Impacts of Research and Technology Organizations, published in October 2010, which may be downloaded from the publications page of the EARTO website.

About this Paper

Horizon 2020 makes a break with previous EU Framework Programmes. It is to be more driven by innovation priorities, especially to help tackle societal grand challenges and build and sustain industrial leadership for Europe in the world.

It seems probable that the new programme will remain focused on funding R&D. The "D" element will be stretched towards demonstrators, pilots, first applications, etc., but the bulk of the programme resources will go to R&D as before. The main innovation spending effort will have to come from industry and from public authorities (Member States, including through Structural Funds co-financing).

However, Horizon 2020's innovation focus means that careful thought must be given to what R&D to fund. Discussions about how public research budgets should be distributed frequently provoke impassioned debate and inflated claims about the superiority of this or that category of research. In Europe, there is a strong and well organized "academic science" community always ready to argue for the primacy of "basic" research: polemics soon ensue, concepts are twisted, clarity is lost.

EARTO therefore commissioned from Technopolis Group - a leading consultancy that analyses and advises on science, research and innovation policy and undertakes policy and programme evaluations for public authorities around the world - a review of the scientific literature on the links between research and innovation, of how governments elsewhere in the world spend on R&D, and the implications for Horizon 2020.

This document summarises and interprets the key findings of the detailed Technopolis report:

Getting the Balance Right:
Basic Research, Missions and Governance for Horizon 2020

The full report may be downloaded from the publications page of the EARTO website.

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Contents

Basic research is only one ingredient in a well-functioning innovation system

Science doesn't drive innovation

Representatives of the research community sometimes claim, or imply, that all innovation can be traced back to an original scientific breakthrough; it follows therefore that science drives all innovation. Innovations do occasionally arise from new science, but mostly they don't.

Innovation feeds on ideas, on the cumulated stock of knowledge

Successful innovations solve problems by drawing on the existing stock of knowledge, sometimes mixing in items of new knowledge. It is the growing stock of knowledge that is critical for innovation. Basic research - i.e. research into fundamental phenomena - like other research adds to the cumulated stock of potentially useful knowledge.

The idea that "relevant" research is somehow low-quality is wrong

When "scientific excellence" is extolled as the sole criterion for research funding decisions there is sometimes an implied argument that use-inspired "relevant" research is somehow of lower quality. There is no empirical basis for this. Researchers who co-operate with industry tend to do better than their colleagues on conventional measures of scientific quality and productivity.

Much basic research is application -oriented

The notion that basic research is always pursued without considerations of practical use is wrong. Much basic research is done by scientists who have clear ideas of application, and governments fund much more mission-oriented basic research than "pure" basic research.

In advanced, knowledge-based economies like ours, a mix of research is needed to "push the technological frontier". Less developed economies can compete economically with their more developed competitors by focusing on "catch up" research. An example is China, where spending on research has exploded over the past two decades, but where the share of basic research has stuck at only 5% of the total.

Most basic research is inspired by considerations of use

Pasteur's work that culminated in the discovery of microbes was motivated by a desire to improve public health.

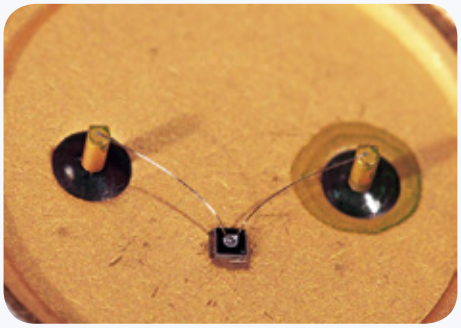
copyright Institut Pasteur

The idea that technology is always science-driven is wrong

When the first airplane flew, there was no scientific explanation of how powered flight was possible. It was another 20 years before the science of aerodynamics had caught up with the reality of powered flight.

Science and technology frequently co-evolve

The transistor is another major innovation that was developed "despite" the absence of scientific understanding of the underlying principles. The technology drove the science. The same is true of miniaturisation in micro-electronics ("Moore's law").



A mix of research is needed to "push the technological frontier"

For all of the above reasons, basic research is one necessary ingredient in our innovation systems. But it is only one ingredient in a well-functioning whole that must effectively link producers and consumers of knowledge, as well as the many intermediate functions of development, design, prototyping, manufacturing, etc.

What is the right level of investment in basic research? In many advanced countries its share in total R&D is about 20%

Because basic research - both mission-oriented as well as researcher-initiated - is inherently high-risk, it must be able to rely on public funding. What, then, is the right level of public investment? In a basket of advanced countries the share of basic research in total R&D is around 20%. Horizon 2020 allocates some 21% of its proposed budget to the researcher-initiated ERC and FET[1] activities alone. Since some other parts of Horizon 2020 will fund mission-oriented basic research, there seems to be too much support overall for researcher-initiated basic research and not enough effort on innovation missions.

[1] European Research Council (ERC) and Future and Emerging Technologies (FET).

The "European paradox" is not about failing to extract value from basic research. Europe is simply not good enough at innovation

We cannot fund only curiosity-driven research if we want science to contribute to the solution of societal problems

The "European paradox" is the idea, coined in the Commission's 1995 Green Paper on Innovation, that Europe does excellent research but that, paradoxically, research does not make us economically successful.

The real paradox is perhaps that there are still so many people today who believe that more and better science will always produce more and better innovation and hence economic competitiveness.

We need mission-driven research that focuses on solving problems

This kind of thinking is a variant on the "linear model" of innovation, long since discredited in the scientific literature but surprisingly still very influential among policy makers. A current example is the idea that we must do more to extract value from publicly funded research. This assumes that immediately exploitable value is always present in what is being researched but that we are somehow unable to see or use it. The argument is encouraged by some in the academic world, for it tends to transfer responsibility from those who perform research to those who fail to exploit its value.

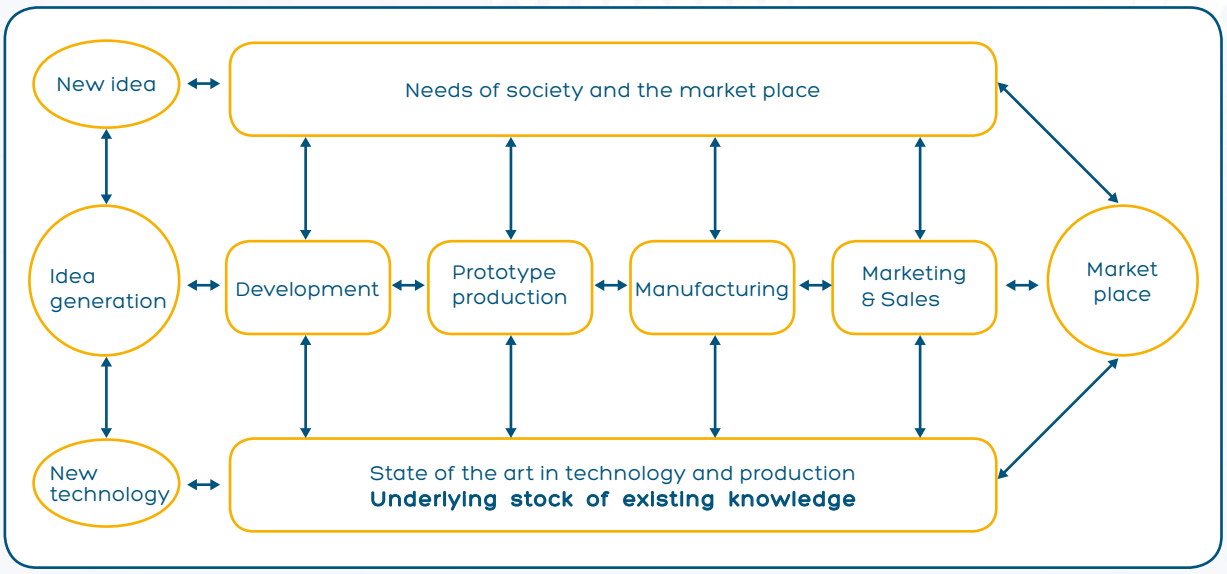
Scientific ideas have no market or societal impact until they are coupled to users' needs

Innovation is sometimes triggered by a scientific discovery, but more often it is driven by problem-solving. This means that innovation-oriented research must connect with users and their needs.

The route from research to social and economic impact is invariably non-linear and sometimes long. It is affected by many other factors than the scientific or technological content of the research, such as markets and the availability of the complementary knowledge needed to solve particular problems. Innovation-oriented research funding must be patient and sensitive to the context, interacting with people knowledgeable about needs and the state of the art in knowledge.

The linear model of innovation – the idea that basic research leads to applied research which produces innovation – is scientifically discredited

Modern innovation theory emphasizes the coupling of knowledge supply (the existing stock of knowledge, not just the results of new research) and demand (the needs of actual and potential users), and stresses that the role of policy is not only to provide research funding but to ensure that the linkages between the different functions are present and effective.



Source: Modified from Roy Rothwell, 'Towards the Fifth-generation Innovation Process', International Marketing Review, 11 (1), 1994, 7-31

Horizon 2020, like previous recent Framework Programmes, must adopt such a systemic approach in order to succeed as an innovation programme and this will require a complex policy intervention because of the need also to ensure sufficient cross-national linkages, including with Member State policies and programmes.

China's spectacular growth since opening up to the world has been built on a massive expansion of its research and innovation system. Chinese R&D spending is extremely focused on technology development.

Governments target most of their R&D expenditure towards specific goals, spending less on undirected research than is proposed in Horizon 2020

Across the world, governments generally channel most of their R&D spending - even excluding defence expenditure - towards the achievement of policy goals, allocating a considerably smaller proportion of the available money to undirected research in fact than is proposed in Horizon 2020. A good deal of the research they fund is mission-oriented basic research, and most of the funding is managed by agencies with a policy agenda rather than scientific governance.

The EU High-Level Group on Key Enabling Technologies says Europe must refocus on technological research, product development, and advanced manufacturing capability

In Europe, we have largely abandoned the historical role of the state in acting as lead customer and often co-developer of new technology, e.g. railway locomotives, telephone switches, new types of power stations and so on. Others - notably the USA and China - have maintained a more developmental policy where large mission-driven programmes and procurement build and maintain capacity in areas of importance to industry and society.

The recent report of the European High-Level Group on Key Enabling Technologies[2] has clearly flagged the need for Europe to return to a more technology- and development-oriented policy.

[2] High-Level Expert Group Report on Key Enabling Technologies, Brussels: European Commission, 2011

For Horizon 2020 as an innovation programme, key watchwords must be: focus, balance, and governance

The key weaknesses of the European research and innovation system are in innovation activities. Doing more science will not repair them

Europe suffers from significant weaknesses:

- stagnation in the level of research and innovation effort, especially in business
- too few new companies that shake up and renew the industrial structure (or reinvented old ones to the same effect)
- failure to modernize research and education institutions and properly to link them to the rest of society
- fragmentation of research effort among Member States

Focus: expand problem-solving R&D, especially technological research, product demonstration and competitive manufacturing

Doing more science will not repair the key weaknesses of the European research and innovation system. Rather, there is a need to expand mission-driven R&D for tackling industrial and societal needs.

A recent study of the long-term impact of the Framework Programme concludes that it is a successful, complex intervention addressing research and innovation networks and systems. As a pre-competitive, open innovation initiative, it transfers a lot into and out of the stock of knowledge, an activity that inherently has high positive spillovers.

The Framework Programme's increasing focus on coordinating and re-optimizing the European innovation system at the European level helps break national lock-ins and increases the rate of innovation. It empowers stakeholder groups to develop and exploit their own strategic intelligence and so captures and exploits the power of self-organization rather than rely on central planning.

Balance: continue to fund a mixture of basic and applied research, but increase the effort on development and related functions

What is important is to strengthen Horizon 2020 in ways that relate to the weaknesses in European innovation, for example by investing in the three pillars described in the KETs report: technological research, product development and demonstration, and competitive manufacturing.

The implications for Horizon 2020 are clear.

- Focus resource increases on the innovation-relevant parts of the targeted industrial and societal missions
- Continue to fund a mixture of basic and applied research within those missions, but increase the effort on development and related functions
- Do not increase the ERC effort, which already has an appropriate share of the proposed resources, and encourage the ERC to continue to work with national research councils so as to increase overall quality levels of research in Europe
- Increase the volume of EU Structural Fund resources devoted to innovation and strongly couple Structural Funds and European Investment Bank resources with Horizon 2020 priorities and resources
- Ensure that Horizon 2020 policies and actions are forward-looking and driven in a long-term perspective since they concern the innovation capabilities of EU industry in the next decade and beyond

Governance: ensure enduring focus on innovation priorities through dedicated high-level advisory "Innovation Councils" of key stakeholders for each societal grand challenge and for industrial leadership[3]

[3] EARTO has several times called for the creation of such over-arching Innovation Councils (cf. EARTO Position on the Next Generation of European Union Research and Innovation Programmes, January 2011). The European Parliament Horizon 2020 Rapporteurs Carvalho and Madurell have both made similar proposals for "Advisory Boards", while ERAB goes a step further still in proposing arms-length agencies to manage large parts of Horizon 2020, acting not just as funding bodies but also as "change agents", and involving stakeholder representatives in their governance.

EARTO

- is the European trade association of the Research and Technology Organisations (RTOs), a non-profit organisation founded in 1999
- promotes and defends the interests of its members towards European institutions and others
- provides its members with information and networking services to help them make the best use of European programmes relevant to research and innovation, to identify and develop joint interests, and to exchange professional experience and good practice
- groups over 350 Research and Technology Organisations with a combined staff of 150,000, an annual turnover of €15 billion, specialised equipment and facilities to a value of many € billions, and more than 100,000 customers annually

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