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Directorate-General for Research
Directorate C – European Research Area: Knowledge-based economy
Unit C.3 – Economic Analysis and Monitoring of
National Research Policies and the Lisbon Strategy
Contact: Werner Wobbe
E-mail: Werner.Wobbe@ec.europa.eu
Internet: http://ec.europa.eu/research/era

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Foreword by Commissioner Janez Potočnik

Globalisation is profoundly changing the relationships between Europe and other world regions. Emerging economies are new competitors and at the same time they provide new markets for our industries. Globalisation places new demands on resources, presenting new challenges and new opportunities for cooperation and competition. In parallel, the world still needs to fight against poverty, hunger and disease and we have to deal with the unintended consequences of human activity on our environment and climate.

The scope and size of these challenges are too large for a single Member State to address these alone. We need the best brains, knowledge and technologies available at European level and we need to apply these in innovative ways to cope with the challenges considering the fact that knowledge creation, diffusion and exploitation are increasingly driving the competitiveness of our industries and the sustainability of our economy.

Policy makers need to develop the right education, research and innovation policies to move towards a knowledge-based economy, but they need guidance in doing so. Soon after I started as Commissioner for Research, I brought together a group of eminent European economists to advise me on crucial issues that we need to address on the way to a knowledge society. They were chosen to reflect a mixture of academic disciplines, competences and practical experience. The group is called the 'Knowledge for Growth (K4G) group' and I sometimes call them my knowledge economists.

The main task assigned to the K4G Group was to discuss the most up-to-date results from policy research in the fields of education, research, technology and innovation that are of relevance for sustaining European economic growth. Issues such as the so-called European R&D deficit, the governance and coordination of science and technology systems, the globalisation of R&D, the complex interrelations between technology production and diffusion, the connections between university and industry were explored in great depth.

The group put forward the concept of smart specialisation. This is fundamental to the realisation of a European Research Area – our way of achieving a world-class public research base. Today, Europe's research base today is still too fragmented – despite all previous efforts and achievements. We therefore need a process that creates the right conditions of competition and co-operation to support the emergence of world class, specialised clusters – achieving what we economists call 'agglomeration effects'.

The K4G Group has identified four major objectives that European Research Area (ERA) policies need to focus on:

- increasing the free circulation of research, researchers and technologies to realise the 'fifth freedom', the free movement of knowledge;
- creating networks of modern universities and research organisations to deliver excellent science and technology throughout Europe with an optimal mix of specialisation;
- putting in place the best possible framework conditions in Europe to attract and retain researchers and research investments;
- demonstrating obvious benefits for all citizens from the contribution of large-scale R&D efforts in solving major problems of society.

Their policy recommendations have strongly influenced the development of a 'Vision 2020' of the European Research Area, which was endorsed by the 27 Member States at the European Competitiveness Council on 2 December 2008. This vision is part of the Ljubljana process, a partnership between the Member States and the Commission, which creates political momentum for the overall development of ERA.

I am always eager to read a new report from my knowledge economists, particularly if they challenge conventional wisdom. I hope you will appreciate their reports as well.

Overview on Knowledge for Growth: European issues and policy challenges

Dominique Foray and Bart van Ark, Vice Chairmen of expert group 'Knowledge for Growth' (K4G) ([1])

This article presents the focus of discussion of the 'Knowledge for Growth (K4G) Group' and the issues it addresses on the complex relationships between science, technology, innovation capacities and economic growth in the European context.

During its existence, the Group has discussed four reports, one draft report and the outline of four further reports ([2]). The reports aim at reflecting an issue relevant for a research policy debate without providing detailed policy recommendations. In order to interact better with the international research policy community the Group issued Policy Briefs that summarise the key messages of each report.

The objective of this brochure is to present the currently available Policy Briefs and to give an overview on the work of the 'Knowledge for Growth' Group. The reasoning of the Group is as follows:

R&D deficit: a symptom rather than a cause

Of course R&D is an input and cannot be taken as a strict proxy for innovation performance. However, economists do believe that R&D has an impact on firm growth, profit and value. Although true that a company's performances are highly unpredictable and dependent on a great many other factors, the relationship between R&D and a firm's growth and profitability has been demonstrated by a multitude of econometric studies. So the existence of a R&D deficit – the fact that business R&D expenditure in the EU is 30 % below that of the US – is clearly a matter of concern for policy makers and experts in the area of science, technology and innovation.

The report by **Mary O'Sullivan** qualifies the deficit as a symptom rather than a cause – a symptom of the EU's difficulty in developing new activities and making new firms grow quickly and significantly. Consequently, in most traditional sectors there is no R&D deficit at all: for example, in the automotive, chemical and aerospace industries, EU businesses spend at least as much on R&D as their US counterparts. In other words, the R&D deficit primarily occurs in the production of information technology (IT) goods and services. EU firms are weaker in technology-based sectors, with new firms less able to expand. Industrial structure and transformation are therefore crucial to understanding the EU's R&D deficit *vis-à-vis* the US.

But the growth deficit is also about the 'productive use' of IT in main user sectors such as retail, wholesale and financial services. So, the IT revolution's great potential for innovation and productivity

1. The group is chaired by J. Potočnik. The Vice Chair position has been assumed successively by B. van Ark and then D. Foray. The list of members is attached. The secretariat support has been provided by the EC and the effective work is greatly acknowledged.
2. See at page 29 the details of the K4G Group. This article does not provide a summary of the reports but rather tries to articulate and organise the numerous ideas, arguments and provocations generated during the meetings, in the reports as well as in other short documents written by K4G Group members to address specific issues raised by the Cabinet of the Commissioner.

challenged Europe, and Europe did not respond well (with a few national exceptions) both on producer and user sides. Since European failures involved invention, production and use of the general purpose technology of our modern economies, the cost of falling behind in this field has been great in terms of growth and productivity.

These reflections raise a number of issues for the future of Europe:

- The deficit, influenced by the failure to develop new activities in IT, may reflect at best an *historical* failure for Europe, whose effects, notably stagnation of productivity, would then be limited in time. But the concern is that the deficit might represent a more permanent failure in the capacity of the European economy to generate new activity and ensure the rapid growth of new technology-based entrants. This could then be repeated in emerging areas of innovation, such as biotechnology and nanotechnology. In such a case, the design of frameworks and institutional conditions must be examined for their potential to bring about a rapid change in new activity development.

- Successful IT *producers* certainly reaped the initial benefits of the IT revolution but more recent data show that efficient IT *users* (in sectors like retail, wholesale and securities trading) are rapidly emerging as the main productivity drivers. The dissemination of a general purpose technology (involving new application development) is as important as invention in terms of their respective contribution to productivity growth. In such a case, what really matters is perhaps to be the best user of new technologies and to adjust institutions accordingly, while leaving invention to other – perhaps better prepared – regions.

- Countries' different specialisation structures are certainly part of the key to understanding Europe's difficulties in achieving R&D objectives. However, we contest the argument that these structures in Europe render additional R&D useless, which would explain the persistent lagging behind of R&D and provide a good reason for abandoning the 3 % objective. This argument is based on a static vision of the economy. R&D actually enables specialisation structures to be transformed; it also allows a somewhat traditional activity to be transformed into a knowledge-based activity. Any kind of R&D target (e.g. 3 %) is therefore not out of step with the European economy – on the contrary it is designed to help it change.

- There is an important role for the public research sector and the European Research Area. The health and productivity of the main knowledge sector industries and services are dependent on an adequate supply of new knowledge, highly-skilled people and academic collaborations; knowledge resources that the public research sector should provide in adequate quantity and quality. However, emulating the US model to deal with this issue might be a more difficult policy option than expected – and perhaps simply irrelevant for Europe.

- One recurrent argument about European innovation's failure deals with the weakness of very large strategic programmes to solve targeted structural problems through centralised and concentrated R&D investments. Such initiatives are supposed to play an important role in catalysing efforts, creating coalitions, coordinating plans and aligning incentives and expectations toward desirable scientific and technological developments.

- Attraction and agglomeration of knowledge resources (ideas, people, labs and services) are also key elements in the constitution of a vibrant knowledge economy. Therefore the global

game of R&D internationalisation – leading to a new geographic distribution of research capacities around the world – is a game in which Europe must be a successful participant; which raises the issue of building attractive knowledge hubs and making countries and regions able to engage in the so-called 'smart specialisation' process.

- Finally, the governance and coordination of research systems is highly significant. In order to achieve the Lisbon objectives as well as allowing regions to engage effectively and efficiently with a smart specialisation process, important policy and institutional reforms are still needed. Such reforms will guarantee an open, integrated and competitive European Research Area, and have been discussed in depth during the course of the last year's K4G group's meetings.

Institutional challenges to deal with the development of new activities

Given the role played by enterprises and industrial structure and dynamics in explaining the R&D deficit, policies confronting barriers to innovation in specific industries and types of firm will likely be more effective than a more generalised encouragement to increase R&D spending.

In Europe, experts and policy makers have not effectively understood the structural changes in corporate R&D that have occurred over the last 25 years in the US and at a more modest pace in Europe. These structural changes have involved:

- an increased role of small firms as R&D performers;
- growing R&D investments by non-manufacturing firms (including R&D-specialised firms, as well as firms specialised in any kind of innovation services);
- an increased vertical specialisation in innovative activities and the creation of more complex industry structures involving the entry of new firms into narrow segments of the industry value chain, which are placed in the upstream phase of the innovation process;
- a growth in patenting and licensing (including academic patenting);
- a growth in R&D and technology-based company alliances;
- the internationalisation of R&D.

When these pieces of the puzzle are assembled, they provide a meaningful picture of, as D.C. Mowery (2007) argues in a recent paper, *a greater reliance on market relationships for the governance of R&D and innovative activities.* And we can clearly see a co-evolution of corporate R&D structures and the institutional framework in the US, but not in Europe. Our institutions therefore need to be adjusted to better match the new structures and organisation of innovative activities in emerging fields. We need the proper institutions for an effective development *of this economy of start ups, fast movers and new industries.* Institutions in continental Europe are rather weak in promoting economic dynamism, in terms of entrepreneurship and the ability of financial markets to steer finance towards worthy innovations. In fact, they tend to be good at suppressing this dynamism. Therefore the relatively poor economic performance of Europe results in both the underdevelopment of capitalist institutions like venture capital and equity finance, and the overdevelopment of corporatist institutions which suppress innovation and competition. These corporatist institutions impose penalties, impediments, prohibitions and mandates generally intended to dampen down 'creative destruction'. There is, therefore, a case for continental Europe to create a new balance between capitalist institutions and corporatist institutions. This is why the Lisbon agenda should be mainly about overcoming institutional inertia, to paraphrase a recent book by German historian Eichengreen.

These institutional innovations should include:

- The design and provision of tailored financing solutions to emerging firms.
- The design of mechanisms and policy to facilitate competitive entry in new industries and services dominated by new structures (lowering the cost of creation of new firms and the cost of growing from new to competitively established firms).
- The creation of a cost-effective patent system.
- The increase of institutional flexibility in labour markets to minimise the cost of innovation when defined in the Schumpeterian sense as involving 'creative destruction'. However 'easier destruction' through labour market mechanisms will be socially acceptable and economically efficient only if individuals have acquired the capabilities to confront constant changes and to transfer their skills from one learning setting to another. Increasing flexibility in labour markets is an efficient option if sufficient investments are devoted to professional training and long-life learning.

For most countries in continental Europe, the Lisbon agenda is therefore about supporting the promotion of economic dynamism through 'creative destruction', within societies that give a premium to insiders, security and risk aversion; and should help them to change their institutions accordingly (Soete, 2009).

Average producers or best users?

It is clear that institutional change of this kind will come with considerable transition costs, which are likely to outweigh benefits for some time. Therefore, we need to be sure that becoming the first producer of the next high-tech and general purpose tool (GPT) is the only available strategy for Europe. We know from recent studies (van Ark *et al.,* 2007) that a significant part of productivity growth comes from the productive use of ICTs in sectors like retail, wholesale and financial services. Deploying and using ICTs productively and efficiently in important application sectors makes a great difference – the final episode of the 'new economy' involved GPT spillovers, generating positive externalities in the wider economy (due to the co-invention of applications in large user sectors) which in turn improved economic return on invention activities. In fact, Europe was not only worse than America at inventing ICTs but also at using them (Bloom *et al.,* 2007). So becoming a 'lead user' might be a strategy to consider.

While it might not be certain that building a strong capability in advanced technology production is necessary in order to exploit the gains from these sectors' technologies and that much has been gained through its use, it is nevertheless plausible that the best users are very often geographically close to the best producers. The report by **Georg Licht** develops this line of argument: the invention of new general purpose tools often goes hand-in-hand with the development of applications across many users' industries and services. These complementarities need to be exploited effectively and this is more likely to happen between the two sectors if they are located within the same 'geographical space'. So the fact that US firms 'use IT better' cannot be separated from the fact that IT inventions have for the most part come from the US.

Increasing research efforts in Europe: still a relevant objective

There is mounting criticism regarding the famous '3 % objective', intended to increase Europe's research and development effort to the level of 3 % of the GDP by 2010. Let us recall that this objective, set in 2002 as part of the Lisbon Strategy, was the result of a persistent R&D deficit being observed between Europe on the one hand and the United States and Japan on the other, which the majority of experts considered to be one of the main reasons explaining the sluggishness of European growth. The most interesting and challenging criticism is about the 'method'. Many experts denounce an objective that is the same for everyone and therefore ignores the structural effects of specialisation. In short, we are acting as if the problem of the R&D deficit in Europe were essentially a problem of financing whereas, in the eyes of these authors, it is primarily a problem of specialisation: a great many European countries are specialised in sectors that quite simply do not require any additional R&D. Although you may imagine the best R&D support programmes and the most generous projects, the tourism or fashion sectors will never be transformed into R&D-intensive activities. While the pharmaceutical industry is a large R&D consumer, the metal working industry is not, and so on. Thus, for many countries dominated by low R&D-consuming industries, the 3 % objective is not relevant ([3]).

In our opinion, the debate on the specialisations of European economies is essential but must not be used as a reason to give up trying and abandon the objective. Following are three arguments supporting the view that the objective must be maintained, in spite of – but also because of – the dominating specialisation structures in Europe.

First, R&D investments make a crucial contribution towards transforming a country's specialisations. The countries that emerged triumphant between 1995 and 2000 (particularly the United States, Finland and Sweden) clearly turned out to be those countries that during the preceding period had managed to profoundly renew their knowledge base and create industries of the new economy. Here R&D counts at both ends of the chain, on the one hand as a triggering factor in the transformation of specialisations and emergence of new industries, and on the other as an increasingly useful and efficient resource as this transformation progresses.

Second, even when specialisation remains unchanged, R&D plays a role in modernising the so-called traditional sectors and easing their move into the knowledge economy. Spending money on research in traditional industries may thus prove extraordinarily profitable, as the example of the mechanics sector in Germany or Switzerland undoubtedly demonstrates. Thanks to R&D and innovation, these countries offer extremely innovative product ranges – even if 'they are only machine tools' – in a world market in full expansion. The traditional machine tool sector in these countries has simply shifted into the knowledge economy – and R&D has played a central part in this scenario.

Third, the 'D' of R&D must be specifically taken into consideration, as it is the area that must significantly increase in many activities. The current period has been marked by the advent of

3. It should be recalled that the 3 % objective is not a target for each and every Member State but for the EU as a whole. In 2005, each Member State was asked to define its own target (not necessarily 3 %).

a general purpose technology (information technologies) whose principal property is the provision of a multitude of innovation opportunities in all sectors, without exception. A basic condition for the realisation of these opportunities is definitely investment in the 'D' of R&D in every sector, including tourism, education, fashion and all the other services.

Essentially, a static vision of our economies' specialisation structures should be avoided, that is to say one that sees them composed of a concretely-defined R&D-intensive sector, surrounded by a gap unbridgeable for other industries. On the contrary, the industrial dynamic is characterised by a strong tendency that nonetheless varies between countries, that of the transformation of industries as they change their 'fundamentals' in the areas of knowledge and innovation production and management. In these transformations, R&D plays an essential role and the 3 % objective therefore also – and perhaps especially – concerns those industries known as 'low-tech'.

Only connect: Public research organisations and the European Research Area

The report by **Paul David** and **Stan Metcalfe** starts with the strong argument that there is much more to the process of innovation than R&D. Innovation requires the access and combination of many more capabilities and kinds of knowledge than could be summed up by the phrase 'science and technology': knowledge of markets and organisations and factor input availability are key aspects for innovation and not the specialisation of public research organisations. So a division of labour exists between public research organisations and companies. In the business of innovation, a public research organisation will never be more than a second rank institution. The existence of this division of labour raises the issue of the connection between the two worlds. Specialisation is a good thing but can create boundary problems that impede interactions between organisations, of which there are two types. The traditional interactions cover networks of people, collaborative funding of research programmes and informal contacts: recruitment of graduates in the business sector is part of this concept and often appears as the strongest channel of interaction between the two worlds. The other sense of interaction is having universities better exploit their inventions – through the professional management of intellectual property, the opening of technology licensing offices and the launch of their own spin-offs and start ups.

While the first of these respects the division of labour between public research organisations and commerce, the second seeks to transform it by bringing public research organisations more fully into the market. Policies to promote commercialisation activities and the licensing of invention by European public research organisations are being considered, fuelled by a widespread supposition that public research organisations in Europe are dangerously disconnected from private sector innovation processes. But this does not tally with a wider understanding of research and business interactions. Policy makers have to be careful when they call for more commercialisation activities, for the following reasons:

- Europe's lack of university patents is more representative of a lack of university-owned patents, than of a lack of contribution by universities to the innovation process, as there are many other ways that the two come together.

- It is not easy to predict the effects of commercialisation activities on academic systems.

- The opposite discussion is now starting in the US – has the system gone too far in the licensing direction, at the expense of a more general promotion of collaborative efforts between the two worlds?

- The structure of most European economies (in terms of firm size, employee qualifications and technology specialisations) is not appropriate for interactions mainly based on patenting and licensing by public research organisations.

Strategic initiatives

The role of the Departement of Defence (DoD) and other federal agencies in the US is always taken as an example of an effective mechanism which greatly influenced the location in the US of the computing and IT revolution. However, what really explains the strong contribution of defence R&D programmes to the US innovation capacities of the 1990s was the identification of investments in this area with specific, high-priority government missions based on national security. As Mowery (2006) argued, the US has failed repeatedly to replicate this model in energy R&D because of the lack of a strong link between public R&D spending and any government mission with strong political support.

Now we are entering an era of global and systemic crises (climate, energy, food) which are clearly challenging the security of nations and people, thereby creating significant opportunities for collective engagement towards R&D and innovation: strong intersections exist between these global challenges and the full deployment of general production technologies (GPTs) to bring their solutions. Climate change, food problems, healthcare and ageing societies, energy and the environment are areas where R&D is emerging as the solution to structural problems. This might help create coalitions among Member States and private and public stakeholders on the basis of credible commitments to R&D programmes which can appear as the cross-section solution of structural problems.

As an example, Rosenberg has recently argued that the notion of sustainability relies very heavily upon an economy's scientific and technological sophistication – which in turn is dependent upon R&D capabilities.

So crises are good news for innovation policy – as an instrument to mobilise and increase commitments – if our economy has the ability to shift research capabilities to a more productive use whenever possible. This big 'if' is a critical determinant of success.

The 'if' implies a non-neutral allocation process with respect to technologies and sectors. Such a broad policy would involve a consistent and concerted set of actions related to the support of knowledge infrastructures (basic science, higher education and training, technology platforms), the creation of incentives for the private sector and demand-side initiatives (public policy to support innovation has proven to be especially effective when R&D funding has been complemented by policies supporting innovation take-up) – all these actions targeting a particular technology or sector.

But departing from neutrality is always dangerous since it implies guessing future technological and market developments. So a central question is about 'programme design': how to make these mission-oriented large programmes less vulnerable to government failures, wrong choices, picking winners and market distortions. Complementarities with competition policy are central, as well as the presence of more than one funding agency with different but overlapping agenda. It is also important to avoid pre-defining the design and architecture of technology through central planning, but rather to let the market discover the best technologies; even if it is done under the logic of a mission-oriented policy. Such programmes should also be designed to foster the entry of new firms into emerging industries; not just to help the large firms already in place.

Strategic initiatives are important, but the design of resource allocation principles is also critical.

Attracting knowledge resources and building knowledge centres: the importance of smart specialisation

One matter of concern shared by many European science and technology experts is that Europe is losing ground as a centre for research and innovation. Dominique Foray's report states that, while European companies are increasingly looking outside Europe for their R&D, overseas companies are less and less inclined to base their R&D in Europe. EU companies' investments in the US are on average much higher than R&D investments of US firms in Europe. And perhaps more worryingly, surveys investigating R&D managers' anticipations of their next location decisions tell the same story: a strong majority of respondents anticipate increasing R&D in China and India, and decreasing it in Europe. This is a serious problem since R&D internationalisation involves the allocation of a very precious resource for our modern economies.

One solution would be to create global R&D hubs which can compete with foreign hubs to attract more research capacities and other knowledge resources. The creation of successful hubs is likely if a region is attractive enough to agglomerate knowledge resources. Though knowledge resources – human resources, ideas, labs – are increasingly mobile and fluid, where they move to is far from random. Star scientists will move to work with other scientists, or with high-tech firms. Corporate R&D will gravitate to strong universities. Innovation service providers will appear close to large R&D companies. This is called an agglomeration process, and it benefits those participants in a position to profit from the accumulated pool of talents, ideas, services and infrastructures in that particular region. This in turn acts as a powerful force in attracting further R&D capacities from foreign countries.

The European Research Area could be analysed as a mechanism to make better use of R&D investments through economies of scale and scope, and spillover. The ERA is also likely to 'liberate' the agglomeration process, as it involves the creation of a research space where full mobility and competitive entry are the rules: centres of gravity will emerge and R&D resources unable to compete at international level will no longer be sheltered by national systems and policies.

It is not so difficult for policy makers to see which levers must be activated in order to become regional winners in the ERA. Once a competitive mass of knowledge resources is created, the hope is that it will have a snowball effect – more resources will be attracted and the region will ultimately reach the scale of global knowledge centre. Clearly, investment in education and

knowledge infrastructures are key. However, outcomes are hard to predict – as the old maxim goes: beware of investing in things that can move. Knowledge resources can be attracted by a proper fiscal and infrastructural policy; but they can also leave if better conditions are offered elsewhere. A critical issue for most regions in Europe is therefore to succeed in particularising their knowledge base; achieving what we call a 'smart specialisation' process.

A region that succeeds in particularising its future knowledge base will enjoy many benefits: it has few other competitors for resources (the two or three other regions which selected the same specialisation areas); critical mass is therefore easier to reach and the agglomeration economies less difficult to create; and the produced knowledge resources (for instance human capital) are co-specialised assets with the risk of them moving away limited.

It is important to highlight here that the search for smart specialisation does not involve a bureaucratic process or an exercise of foresight, ordered from a consulting firm. It concerns an essentially entrepreneurial process, involving the discovery by local entrepreneurs, regional universities and so forth of the research and innovation domains in which a region can hope to excel.

The 'ERA only' will only lead to an extreme polarisation of the European system with no hope for the majority of regions and countries to play any role in the global game. It would be wiser to think of a more distributed research capacity system with centres emerging as a function both of national system integration (accelerating agglomeration) and 'smart specialisation'.

The policy debate should thus move from the concept of 'ERA-only' to a sort of 'ERA-plus', involving strong agglomeration processes and 'smart specialisation', to generate a more distributed structure of first-class regional centres.

Coordination and governance of research systems in Europe

As explained above, 'smart specialisation' in the global knowledge society is not achieved through a foresighted political process, but by letting ideas, innovations, and researchers *compete without barriers, in a large, open and fair field,* as the ERA could be. Currently, the ERA is a vast field, extending beyond EU borders, yet unfortunately national or regional boundaries and regulations often define the extent to which ideas, innovations and researchers compete. In order to be externally competitive, the ERA not only needs to be open with respect to the outside world (becoming an area of attraction for researchers, innovative firms and R&D investments), but must also be 'open within'.

A 'fair competitive field' means that institutions and rules guarantee fair R&D competition, but it also means that each region within the ERA needs a fair chance to compete and become competitive. In an *integrated research area this goal can be achieved* since the emergence of strong R&D agglomerations can, and must, go together with the development of a decentralised R&D and higher education base of excellence across all European regions. Only with such a local base and non-local perspective can regional 'smart specialisation' be possible. Only then can pursuing 'excellence' and 'cohesion' become complementary objectives.

However, to guarantee an *open, integrated, and competitive European Research Area* important policy and institutional reforms are still needed. Some of these reforms would affect EU policies;

while others would affect national or regional policies and institutions. Many of them have already been mentioned in the context of the 'ERA green paper' and its subsequent discussions. We would like to emphasise the importance, at EU level, of having a proper legal framework for setting up competitive European transnational R&D institutions that work with financial rules based on trust and proper science and technology (S&T) evaluation; and the need, at national and regional level, for reforms of public universities and other research performing organisations. These reforms are necessary conditions, but better governance and coordination of S&T polices are also needed. These institutional conditions are explored by Ramon Marimon and Maria Gracia de Carvalho in their report.

Concluding remarks

The economic foundations of knowledge policy are still in their infancy, and we are still stuck with a collection of sectoral policies dealing with R&D, education, IPR, etc. Based on our reports, we believe the building blocks of knowledge policy to be:

- some institutional adaptations to the economy of fast movers and emerging sectors;
- improvements in knowledge infrastructure quality and connectivity;
- the launch of strategic initiatives;
- the development of 'smart specialisation' strategies;
- actions towards a better governance and coordination of S&T policies (this last point especially true in the case of Europe).

However, beyond this commonality of knowledge policy challenges, a particular feature of the EU is that its members have different constraints and opportunities. These differences make it more necessary than ever to 'fine tune' the Lisbon Agenda. At least two main logics of transformation can be identified. For leading countries very well ranked in the innovation scoreboard the critical issue is the development of institutional innovations to promote economic dynamism, competitive entry, start ups and fast movers. The 'catching up' and 'losing ground' countries, however, must focus instead on the more traditional objectives of building a strong science and technology infrastructure through the development and consolidation of higher education, research and engineering capacities, as well as on the absorptive and learning capacities of industries and firms.

Finally, a knowledge policy is not only about financing fast movers, improving the public research sector's productivity and connectivity or launching strategic initiatives; it also has to coherently include *all* these elements to provide the adequate incentives and institutions for the efficient production and exploitation of knowledge.

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What policies are needed to overcome the EU's R&D deficit?

Mary O'Sullivan

The issue:
There has been a lot of focus on the concept of a deficit in research and development (R&D) expenditure in recent discussion on research and innovation policy in the European Union. The deficit is often used to suggest a general problem with innovative activity in the EU, and concerted efforts are being made to induce European enterprises to spend more on R&D, with a view to boosting economic performance through enhanced innovation. However, a close consideration of the R&D deficit, challenges such a straightforward analysis of its implications for innovation policy. Instead, what we know about the nature, causes and implications of the R&D deficit needs to be better appreciated if it is to serve as a useful guide in contemporary policy discussions in the EU.

What is meant by an R&D deficit?

Business R&D expenditure in the EU is 30 % below that of the US, and the €60 billion gap has not narrowed in the last five years. But at individual company and sector levels, numerous EU companies have been investing as much in research as their US counterparts. To understand the R&D deficit, it is crucial to consider industrial structure. The EU's deficit in R&D expenditure *vis-à-vis* the United States primarily reflects a spending shortfall in the production of IT goods and services. This shortfall, in turn, reflects the characteristics of enterprise structure and dynamics, specifically the constraints on rapid growth of new, technology-based entrants in the EU compared to the US. There are reasonable grounds for concern that this pattern could repeat in emerging areas of innovation, such as biotechnology. In short, the R&D deficit appears to be a symptom, rather than the cause, of weakness in the EU's capacity to innovate. The real cause is in fact the structure and dynamics of the region's enterprises and industries.

Question:
Are policies to raise R&D expenditure across all types of enterprises and industries in the EU appropriate to redressing the situation?

Given the role played by enterprise and industrial structure and dynamics in the R&D deficit, it is therefore likely that policies focusing on overcoming barriers to innovation in specific industries and types of firms will be more effective than a more generalised encouragement to increase R&D spending.

What is causing the deficit?

If policies are to be adjusted to redress the particular innovative problems of EU high technology sectors, then the reasons for these problems must be clearly identified.

Questions:
Why is the EU economy weaker than the US in technology-based sectors? And why are new EU firms in such sectors less able to expand than their competitors in the US or Asia?

Perhaps the most common explanation for these differences is a greater willingness on the part of the US financial market to fund new sectors and firms. Greater flexibility in the US labour market is also often identified as an important factor in spurring the emergence of new industries and firms. On the EU side, barriers such as the fragmentation of product markets and the attitude of EU consumers to new products have been cited as potential barriers to innovation.

This is a market-based view of the innovation system. It is also important to focus on the innovation system itself, particularly how its various players, public and private, interact. From this perspective, the relationship between the public sector – such as defence and health systems – and industry is a crucial element. The long-standing and continued importance of the US federal government role in defence and health systems, through procurement, R&D subsidies and other mechanisms, has certainly been a major factor in the success of IT, biotechnology and other dynamic, high-technology sectors.

Although these and other ideas abound about the deficit's causes, most have not been tied rigorously to the outcomes they seek to explain. Moreover, many explanations seem more related to general European R&D shortcomings than to the specific highlighted problems of particular industries and types of firms. There seems little question that more work is needed to identify the general causal interactions and dynamics involved in the emergence of new industries, if policy making in this area is to be systematic. This is particularly important since causes found to be the most salient will force research and innovation policies out of their normal realm in seeking to redress them.

Why does the deficit matter?

Questions:
What has been the cost to Europe of falling behind in IT? Can Europe catch up? Are there lessons to be learnt for other emerging sectors?

Of course, the IT sector is long past its emergent phase and there might well have been important costs in the EU's falling behind that are hard to see now. Moreoever, it might well be that the window of reasonable opportunity for catching up in IT has now passed. Nevertheless, a better understanding of what has been lost in IT would provide context for understanding what could be lost again from falling behind in currently-emerging sectors.

In examining how to address the R&D deficit and its structure, policy-makers need to be clear about the economic and social benefits they hope to achieve by overcoming the EU's lag in new emerging industries. It ought not to be assumed that building a strong capability in the *production* of advanced technologies is necessary to exploit the gains from these sectors' technologies. Based on the example of IT, at least, much has been gained through the *use* of IT. Understanding how these gains might be exploited is, therefore, crucial to designing policies to overcome the EU's lag in this sector. Only if it can be shown that there is an important link between producers and users would efforts to further develop production capabilities in this sector be justified.

There should be a focus not only on economic outcomes but also on the social implications of the EU's lag in emerging technologies. Certainly, in cases such as biotechnology, nanotechnology and new materials, as well as environmental technologies, the social implications of leads and lags seem just as important. However, there is a danger in overstating the role of advanced technology, in and of itself, as a salve for social problems. For example, existing research shows that advances in biotechnology do not translate automatically into improvements in healthcare. Therefore, further serious effort is required to evaluate the social costs and benefits of being leaders or laggards in fields such as biotechnology.

Universities must contribute to enhancing Europe's innovative performance

Paul A. David and Stan Metcalfe

European universities vary widely in their financing, governance, research/teaching balance and interaction with businesses. These interactions with other organisations are important in forming 'knowledge ecologies' from which emerge 'innovation systems'. Public policy makers and university leaders must avoid confusing research and invention with innovation. Research discoveries and inventions are certainly needed to sustain innovation, yet universities are organisations with specialised capabilities that cannot exert effective influence upon many critical conditions – financing, regulations, macroeconomic and fiscal policies affecting business investment demand – that govern the vitality of a region's 'innovation systems'. While stronger inter-connections between universities and businesses are to be encouraged, care must be taken in developing them to suit the particular circumstances of participating organisations. Generally, the principal source of academic knowledge transfers supporting business innovation remains the flow of university-trained graduates – including scientists and engineers. Patent licensing can be a useful transfer channel, but experience in the US shows that too much emphasis by universities on acquiring and exploiting intellectual property rights can hamper knowledge-sharing and collaborative research with the business sector, without solving research universities' collective funding needs.

There are approximately 4 000 higher education organisations across the EU and at least 600 other public research laboratories. Their activities are divided between applied and basic research, and dissemination of that knowledge. Even though one label is generally used in referring to institutions of higher education – 'universities'([1]) – differences among the organisations lumped under that heading can be vast, in terms of their size, balance between research and teaching, range of disciplines covered, extent of commitment to inter-disciplinary teaching and research, and international status. Moreover, the mix of institutions with different purposes and characteristics varies considerably among the regions of the European Research Area (ERA).

1. It is convenient – and now conventional usage (at least in European Commission documents) – to take 'universities' as a collective descriptor for tertiary educational organisations. We do so here without suggesting that in specific policy contexts one may safely disregard the important differences that exist between universities and other higher education institutions such as the *grandes écoles, fachhochschulen, politecnicos,* and other, emerging technical research and training institutes, including the prospective European Institute of Technology (EIT).

Research universities (among other public research organisations) are a natural focus of attention when considering the EU's approach to knowledge generation and innovation. Several concerns have been raised in this context:

- Are there enough EU universities at the forefront of international research to be able to provide EU firms and governments with the best and most relevant research findings?
- Do EU business firms have the capabilities needed to capitalise on the region's universities' research output, and thus interact effectively with them to solve operations problems and develop innovations?
- Should specific organisations exist to connect universities and commercial firms and facilitate 'knowledge transfers' among them?

This briefing focuses on the question: **How should European universities contribute to the improvement of innovative performance by Europe's firms and the region's ability to compete successfully in the global marketplace?** There is a widespread view that the performance of the ensemble of European universities is not adequately responding to the challenges posed by the region's internal needs and intensified global competition. Frequently mentioned reasons include a lack of funding, insufficient coordination of national policies and initiatives, barriers to cooperation among institutions across Europe due to outmoded regulatory and governance systems, inadequate incentives for interactions with the business community, and excessive disciplinary specialisation at the expense of relevant trans-disciplinary approaches in research and training.

Remarkable changes over the last 40 years have created continuing pressures for organisational innovation and institutional adaptation within the European university sector, for example:

- the general demise of centralised corporate R&D laboratories in the manufacturing industry and the reorganisation of corporate R&D around divisional, near-to-market activities;
- the decline of defence R&D, as a result of the end of the Cold War;
- the changed status of many public laboratories in research areas such as defence or metrology, removing them from government – through privatisation or other new forms of governance – and forcing them to search for other funding sources;
- the increased internationalisation of R&D activity (see Forey/Van Ark), as large firms become more willing to engage with universities and technology research institutes on a worldwide scale;
- the rise of 'knowledge-based service' activities, which have increased the importance of forms of 'service sector R&D' quite different fromR&D traditionally performed in connection with manufacturing.

In short, the current consensus among informed observers is that the EC's higher education institutions are urgently in need of 'modernisation' if they are to play their part in Europe's drive to sustain growth and job creation.

The present challenges arise on many fronts well identified by the European Commission's Green Paper on the European Research Area ([2]). Salient among them are: the need for excellent and properly-resourced research institutions able to develop and maintain partnerships with other entities, either through joint research ventures, clusters, or virtual networking; effective

2. See IP/07/469 or COM(2007)161.

knowledge-transfers between public research and industry; and the formation of a cadre of highly competent researchers who are mobile, i.e. willing to move across institutional, disciplinary, sector and national boundaries.

Two other challenges might be added to the Commission's list. First, the diversity of specialised expertise within the university sector must be complemented by that in the business sector, requiring both improved information flows from research universities about the relevant qualifications and talents of their trainees and, on the other side of the market, active demand from the private sector for such researchers and technical personnel. Second, the cooperative ethos of open knowledge-exchange, generally found among academic scientists, should be prominent among the driving forces in university-industry scientific research collaborations. That may require reconsidering the attention given by European universities to efforts to commercialise knowledge gained by their faculties and research trainees.

To state the goals toward which the 'modernising' of Europe's universities should be directed is much easier than to attain them. Bearing in mind their specialised capabilities and institutional constraints, how best can research universities contribute to the formation of an organisational ecology that generates sustained innovation?

An important point of departure in answering this question is that research & invention is not innovation; there is much more to the process of bringing new products and processes into commercial use than R&D, wherever it is performed. University-business linkages form only part of this process (albeit an important part) and their impacts on innovation are not independent of the many other factors that are in play.

It is hard to find an innovation policy document from government, business or university sources that does not call for greater, wider or deeper 'interaction' between private business firms and universities. The obvious and important question is what is meant by interaction?

The modes of connection between businesses and universities are many and varied and used in different ways at different times. They range from informal contacts, attendance at conferences and access to published literature, to recruitment of graduates, staff exchanges and joint research programmes or specific contracts. It is clear, however, that the principle connections that businesses value in the sphere of knowledge-based interactions with universities is the employment of graduates, qualified scientists and technologists. Faced with information needs relating to existing operations and innovation, firms that turn to external knowledge sources are more likely to use their links with clients and suppliers then their contacts with academia.

Yet, in many discussions of universities' role in innovation processes, two very different and sometimes conflicting notions of 'connections' or 'interactions' with business are often lumped together. One conceptualisation looks toward the better connection of universities with firms' innovative activities, through stronger networking arrangements, collaborative funding of research programmes, and foresight activities participated in by scientific and technical experts.

The other sense of 'connection' is about having universities better exploit ideas developed within their precincts, through the professional management of intellectual property, the opening of technology licensing offices and the launch and investment in their own 'spin-off' and 'start-up'

companies, and the development of fee-charging consultancy services. This panoply of commercial activities is sometimes described as the third 'stream' of university contribution to innovation, distinguishing it from the two traditional 'streams' of fundamental research and training.

While the first of these 'connection' concepts respects the division of labour between academia and commerce, the second seeks to transform it by bringing higher educational institutions more fully into the market as a supplier of innovation services. This contrast creates much room for debate about the virtues or vices of each conceptualisation, but, the practical policy issues concern the balance to be struck between universities' engagements in these two kinds of interaction with business.

Approaching this question calls for a proper understanding not only of the benefits, but also of the costs. By pursuing the commercialisation connections with innovation, it is quite possible that universities will sacrifice the individual and systemic gains that would come from forging closer cooperative interactions with firms, based on mutual advantages of research collaboration and personal networks of knowledge exchange.

Further, even though some universities can enter the innovation business and compete successfully with industry players; to acquire and maintain those capabilities requires attention and problem-solving efforts from academic leaders that might come at the expense of responding to the institution's two traditional social missions.

Strong reinforcement has been given by national governments and the EC to European universities' initiatives in obtaining and exploiting patent rights as a means of commercialising the research findings of their faculties. In a significant sense Europe has been following a path pioneered in the US since 1980 ([3]). But there is growing recognition in US corporate and innovation policy circles that the right balance between the two kinds of university-business knowledge-transfer interaction has not been found there; that the pendulum has swung too far toward university research commercialisation based on intellectual property rights. This is reflected in the recently announced Open Collaborative Research Program, under which I.B.M., Hewlett-Packard, Intel, Cisco Systems and seven US universities have agreed to embark on a series of collaborative software research undertakings in areas such as privacy, security and medical decision-making, under terms that commit all the parties to making their research results freely and publicly available.

The longer term consequence of effective university reform is likely to be a more refined division of labour within the research system, with a clear recognition that different models of a modern university are possible: interactions with the business sector will not conform to 'one-size-fits-all' prescriptions, and a combination of incentives and liberalised regulations will permit diverse institutions to adopt different modes of governance that will enable them to compete for varied sources of funding.

3. The Bayh-Dole Act [passed in 1980 as Pub. Law No. 96-517, Section 6(a) 3015, 3019-28, and codified as 34 U.S.C. Sections 200-212 (1994)] simplified and codified the terms on which higher educational institutions conducting federally-sponsored research could seek intellectual property rights for their results.

An open, integrated and competitive European Research Area requires better governance of S&T policies

Ramon Marimon and Maria de Graça Carvalho

It is recognised that strengthening and implementing EU-wide R&D policies is a core practice for the full development of the Lisbon Agenda, but why should we have EU-wide R&D policies beyond those of national and regional governments? One argument is that transnational cooperation in R&D programmes and infrastructures is a stimulus for European competitiveness in the global knowledge society [1], however, 'the main rationale for EU-wide R&D policies is based on the need to develop an open, integrated and competitive European Research Area.' Only within such an ERA can transnational cooperation achieve its full potential and – more importantly – can all European regions find their competitive advantage through a process of 'smart specialisation' [2]. However, to consolidate such an ERA, 'better governance and coordination of S&T policies are needed.'

'Smart specialisation' in the global knowledge society is not achieved through a foresighted political process, but by letting ideas, innovations, and researchers compete *without barriers, in a large, open and fair field,* as the ERA can be. The ERA is currently a vast field extending beyond EU borders, yet unfortunately national or regional boundaries and regulations often define the extent to which ideas, innovations and researchers compete. The ERA not only needs to be open with respect to the outside world (becoming an area of attraction for researchers, innovative firms and R&D investments), but must be 'open within' otherwise it cannot be externally competitive.

A 'fair competitive field' means that institutions and rules guarantee fair R&D competition, but also that each region within the ERA has a fair chance to compete and become competitive. In an *integrated research area this goal can be achieved* by the emergence of strong R&D agglomerations combined with the development of a decentralised R&D and a higher education base of excellence across all European regions. Only with such a local base and non-local perspective, is regional 'smart specialisation' possible. Only then can pursuing 'excellence' and 'cohesion' become complementary objectives.

However, to guarantee an open, integrated and competitive European Research Area, important policy and institutional reforms are still needed. Some of these reforms affect EU policies; others affect national or regional policies and institutions. Many of them have already been mentioned

1. In fact, on the initiative of the EC, the EU is playing a leading role in 'Global infrastructures and initiatives' (e.g. ITER, Global Warming).
2. 'Smart specialisation in a truly integrated research area is the key to attracting more R&D to Europe' argues the Knowledge Economists Policy Brief n° 1, October 2007, by Dominique Foray and Bart Van Ark.

in the 'ERA Green Paper' and subsequent discussions. We would like to emphasise the importance, at EU level, of having a proper legal framework for setting up competitive European transnational R&D institutions that work with financial rules based on trust and proper S&T evaluation; and the need, at national and regional level, for reforms of public universities and other research performing organisations ([3]). These reforms are necessary preconditions, but better governance and coordination of S&T polices are also needed.

In order to achieve the Lisbon objectives, two main weaknesses in the current EU R&D and innovation public governance structure must be addressed. First, most R&D public funds are in the hands of national and regional governments, and while this shows governments' commitment to 'build local R&D capacities', this goal is often not pursued with an open and competitive ERA perspective, which results in fragmentation, weak competition and, possibly, 'distorted specialisation'. Second, the 'complexity' of EU funding (EU financial rules, existing instruments for policy coordination and cooperation, etc.) often acts as a deterrent for scientists and innovative firms, and limits both the leverage capacity of EU R&D policies, and the ability of the EC to lead intergovernmental initiatives.

To confront these weaknesses and reinforce R&D governance, at all its levels, one must take into account the fact that R&D funding institutions – as is the case with financial institutions – can only operate efficiently if they build a good reputation, if they are 'trusted' in how they handle public resources and, more specifically, in how they handle the competitive and selection processes determining resource allocation. Some organisational principles that help to build up 'trust' are:

- independence between the political authority (which may set social priorities and budgets) and 'funding managers' implementing the competitive and evaluation processes;
- independence between 'funding managers' and those who may receive the funding;
- a professional, stable and properly accountable organisation, without which reputation can not be built;
- clear and well known rules for evaluation criteria and selection procedures; and
- simple and timely implementation.

Based on the main objective of developing an open, *integrated and competitive European Research Area,* and on the above 'principles of trust and delegation', we make the following recommendations:

- National or regional governments (and their funding agencies), should not only operate according to the above 'principles of trust' (some already do, others require reform), but also according to the above ERA perspective, e.g. removing effective barriers to open EU competition and taking advantage of EU evaluation capacities ([4]), even if research has to be carried out locally.
- EU institutions, such as the ERC (founded on the above 'principles of trust'), should be open to, and capable of, providing service to national and regional governments, and should design policies and programmes which can have a multiplicative, *leveraged,* effect on national and regional policies ([5]).

3. See, for example the report of the ERA Expert Group 'Strengthening research institutions with a focus on university based research', January 2008.
4. In fact, at the local level the 'independence principles' (i & ii) are often too problematic to guarantee effective ERA competition.
5. ERA-NET+, where the EC provides additional funding to joint calls for specific R&D funding set by a number of national agencies, is a step in this direction. Another initiative in this direction that could help the ERA, is the collaboration of the ERC with national & regional agencies, according to which these agencies (on a voluntary/flexible basis) fund researchers (working in their country or region) who pass the ERC standards of excellence, but cannot be funded by limited ERC funds.

- While flexible coordination/cooperation might be the dominant mode in supporting R&D initiatives (in order to properly internalise economies of scale and scope, and knowledge spillovers), the experience in intergovernmental programmes (e.g. Eureka, ERA-Net, Article 169, etc.) shows the inherent complexity of intergovernmental governance, and suggests a different method of flexible cooperation: *to limit intergovernmental intervention, and the EC leadership, to their policy role of setting and coordinating priorities, programmes and budgets, while delegating the evaluation, selection and management processes to 'autonomous EU funding agencies'*, based on the above 'principles of trust'.
- The current EU (EC) governance structure must be simplified and reinforced. Two alternative paths could be followed:
    - to reform existing institutions according to the above criteria (e.g. strengthen the EC as a 'funding agency');
    - to create new 'autonomous EU funding agencies', to which EC and intergovernmental programmes can be delegated.

In summary, with FP7 the ERA is starting to have a better governance structure, but, aside from the ERC, the current 'diversity and complexity' – though natural in the EU landscape – is a major deterrent to proper competitive participation by scientific and technological communities. Governance through proper EU delegation must be improved, but the ERA's institutional engineering cannot replace the urgent need for coordinated reforms at national and regional levels, so as to guarantee the development of an open, integrated and competitive European Research Area.

Smart specialisation in a truly integrated research area is the key to attracting more R&D to Europe

Dominique Foray and Bart Van Ark

There are concerns expressed at different levels in Europe about the increasing numbers of European companies basing their R&D operations outside Europe, at the same time as the number of overseas companies carrying out their R&D in Europe is falling. This phenomenon of the 'internationalisation' of R&D does not necessarily have to be negative for Europe, say an influential group of economists, advising the European Science and Research Commissioner, Janez Potočnik. But if Europe is to benefit from this increasing trend, it has to make fundamental changes to the way in which R&D is organised there. The creation of truly European centres of excellence will be of more benefit in the long-run than each individual country having low-level expertise in a full range of scientific areas.

R&D has become a global game. There is a perception in Europe, borne out to some degree by recent surveys, that European companies are increasingly looking outside Europe for their R&D, and overseas companies are less and less inclined to base their R&D in Europe. Studies by the OECD and other international organisations show that between 1995 and 2003, there was an increase in US R&D investment in countries like China and India, at Europe's expense. Surveys about European and US managers' anticipations of their next location decisions tell us the same story *(see figure 1)*.

Decisions about where to base research capacities are primarily made according to the availability of new ideas and technologies, highly skilled human resources and academic collaborations. While these resources are increasingly flexible and mobile, where they move to is far from random. Star scientists will move to where they can work with other star scientists, or with high-tech firms. Corporate R&D will gravitate to strong universities. Innovation service providers will appear close to large R&D companies. This is called an *agglomeration* process, and it gives rise to benefits for those participants that are in a position to profit from the pool of talents, ideas, services, and infrastructures that accumulates in that particular region. This in turn acts as a powerful force in attracting new R&D capacities from foreign countries.

Therefore, if Europe is to be a serious competitor in the global game of R&D location, policies need to be adapted to the rules of that game. There are two main areas in which Europe is hampered in its efforts to attract international R&D.

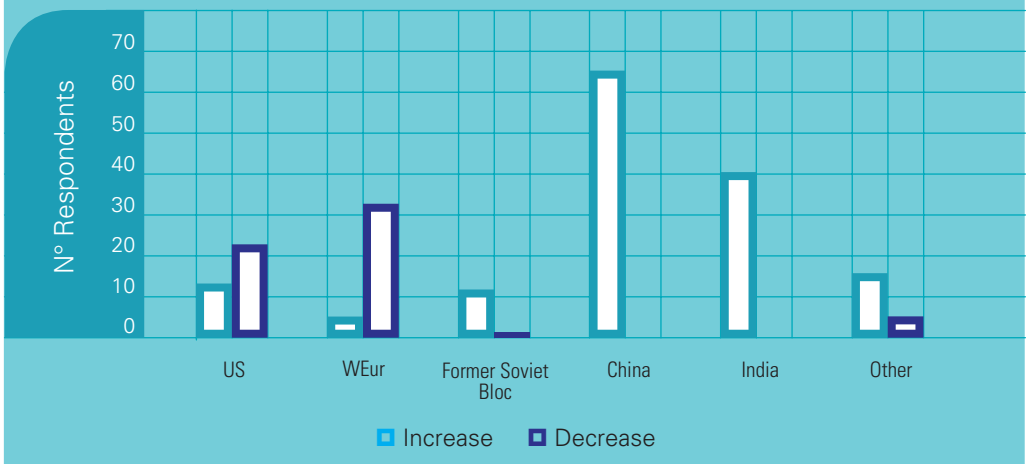
First, the fragmentation along national lines is a brake on the process of creating world-class centres of excellence. It has prevented a more natural development, through agglomeration, of centres of excellence. If allowed to flow freely across national barriers, the best resources in a particular field would naturally find each other and create a centre of gravity.

Second, there is a tendency among countries and regions in Europe to look to emulate what successful regions or countries do, instead of trying to find an original area for expertise. Unimaginative national and regional public policy has overemphasised new science-based leading-edge industry, resulting in a pervasive uniformity of national knowledge bases. This then leads to the spreading of resources and the creation of sub-optimal centres, which cannot compete internationally.

The question is, how many centres of excellence, for example in biotechnology, can Europe afford? There is a high risk of wasting resources if all Member States compete uncoordinatedly in the same area. Limited resources might be spread too thinly to allow excellence to emerge or it might cause the unnecessary duplication of projects and programmes. In a Europe of 27 countries, most of which can be considered 'small', a model involving national development of scientific expertise across the same areas is likely to be inefficient. Equally, the widespread use of local tax credits and other subsidies aimed at promoting the formation of R&D-intensive clusters are likely to hinder the agglomeration process. This in turn means Europe is not reaping the economic benefits of these agglomerations.

Instead, mechanisms are needed to find original areas of expertise. The whole of Europe stands to gain from moving towards an R&D system based on greater European-wide specialisation. Without it, Europe runs the risk of losing the international R&D it hosts at the moment, without attracting new investment to replace it.

Figure 1 – Manager's anticipation of their next localisation decisions



A strong majority of respondents (based in US or in Europe) anticipate increasing their technical staff in China and India while a vast majority of respondents anticipate decreasing their technical employment in Europe.

Source: 'Here or There? A survey on the factors of multinational R&D location', J. Thursby and M. Thursby, National Research Council of the National Academies, Washington D.C., 2006.

The suggestions are therefore that:

- European policy should be adapted to allow the emergence of global centres of excellence across national boundaries, allowing access to the most appropriate technical and human resources.

- A more integrated European Research Area should be put in place, so that R&D resources unable to compete at international level are not sheltered by national systems and policies. By allowing agglomeration to occur, different centres of gravity will emerge. This can only be done within an integrated research space principally characterised by mobility and competitive entry.

- The European Research Area will only benefit countries and regions with clear visions and strategies for developing distinctive, original and modern areas of specialisation for the future. The economic importance of the region, combined with its scientific and technological development, will dictate how broad or narrow this specialisation should be.

- The search for smart specialisation does not involve a bureaucratic process or a top down future plannind exercise. The issue is to let regional institutions (firms, universities) to find their own way through a decentralised discovery process. The role of policy should therefore be limited to support this peculiar entrepreneurial activities and to help those institutions involved to coordinate and be connected in the search process so that a system of innovation is likely to emerge within a certain area of specialisation.

- Regions targeting the same kind of specialisation need to cooperate and coordinate their investment plans to allow for the emergence of a critical cluster able to attract further R&D capacities from foreign countries.

- A particularly good example of this approach is the project BlueBioNet which stimulates regional development in maritime regions.

Regional development through research:
The BlueBioNet example

BlueBioNet focuses on the development and adoption of maritime biotechnology. Four maritime regions (in France, Germany, Great Britain and Spain) are coordinating efforts to strengthen their knowledge base through the development of biotech applications in this specific field. This is a good case of regions with a strategic vision identifying what makes their knowledge base unique and distinctive. Through coordination, these regions worked out that a new technology would modernise and revitalise what is for them an important economic sector. Such a vision allows them to select a competitive arena with few competitors worldwide, in which critical mass is easier to reach. By working together, a critical cluster has emerged and the knowledge assets – people, ideas, labs – are available to all parts of the network, instead of the expertise leaving Europe.

Expert Group 'Knowledge for Growth' (Knowledge economists – K4G)

In 2005, Commissioner Potočnik established a group of prominent economists in the field of 'Knowledge for Growth', called the 'knowledge economists', in order to provide him with high-level advice on the contribution that knowledge can make to sustainable growth and prosperity and related policy aspects in order to support the Lisbon Strategy goals. The K4G Expert Group meets three times a year, under the chairmanship of the Commissioner. The Commissioner appointed Prof. Dominique Foray as Vice-Chairman to lead the work of the Group ([1]).

As a matter of fact, the Group decided not to undertake original research, given that all members have their own research agenda and are also heavily involved in other types of professional activities. The mode of operation of the Group was, therefore, more that of a forum where members of the group present written contributions based on existing knowledge and data, which are then critically discussed at various stages. The final outcome is a *report* developing a policy structured discussion. Each report is complemented with a *policy brief* that summarises the key messages.

The Group has issued four reports and corresponding brief policy papers which are presented in this small leaflet. The titles of the full reports are as follows:

- Globalisation of R&D: linking better the European economy to 'foreign' sources of knowledge and making EU a more attractive place for R&D investment.
  (Rapporteur: Dominique Foray)

- The EU's R&D deficit & innovation policy (Rapporteur: Mary O'Sullivan)

- Universities and Public Research Organisations in the ERA: Fulfilling universtities' critical societal roles in the advancement of knowledge and the support of sustained innovation-driven economic growth in Europe.
  (Rapporteurs: Paul A. David and Stan Metcalfe)

- Governance and coordination of S&T policies in the European Research Area
  (Rapporteurs: Ramon Marimon and Maria de Graça Carvalho)

- A draft report on Balance between technology production and technology use
  (Rapporteur: Georg Licht) has been discussed.

The reports may be downloaded from:
http://ec.europa.eu/invest-in-research/monitoring/knowledge_en.htm

1. The presence and active participation of the Commissioner himself, as well as several key EC officers at each session, was critical to somewhat force the group to delve deeper into the policy discussion than many individual members are used to doing in their professional activities and to bring many important insights and information about the policy work 'in progress' done by the Commission.

Further reports under preparation are:

- Measuring corporate R&D return
  (Rapporteurs: Bronwyn Hall and Jacques Mairesse)

- Managing the transition to the knowledge economy in Member States
  (Rapporteurs: Mojmir Mrak and Reinhilde Veuglers)

- Learning to specialise (Rapporteurs: Anastasios Giannitsis and Marianne Karger)

Policy briefs and the policy debate papers serve to initiate a debate with the wider public.

List of members

- **Chair:** Commissioner Janez Potočnik

- **Vice-Chair:** Professor Dominique Foray (French), Professor of Economics at École Polytechnique Fédérale de Lausanne, Dean of the College of Management at EPFL (CH)

- Professor Bart van Ark (Dutch), Professor of Economic Development, Technological Change and Growth at the University of Groningen (NL) (Vice-Chair of the Group 'Knowledge for Growth' 2005/2006). Executive Director of Economic Research at The Conference Board (US)
- Professor Maria Carvalho (Portugese), European Commission, Bureau of European Policy Advisers. Former Portuguese Minister of Science and Higher Education.
- Professor Paul A. David (American), Professor of Economics at Stanford University (US), Emeritus Fellow of All Souls College, Oxford and Senior Fellow of the Oxford Internet Institute (UK).
- Professor Jean-Paul Fitoussi (French), Professor of Economics at the Institut d'Études Politiques de Paris, President of the Scientific Council of the Institut d'Études Politiques de Paris (FR).
- Professor Anastasios Giannitsis (Greek), Professor of Economics at the University of Athens (EL). Former Greek Minister of Foreign Affairs and Minister of Labour and Social Security.
- Marianne Kager (Austrian), Chief Economist of Bank Austria Creditanstalt (AT).
- Professor Bronwyn H. Hall (American), Professor at the University of California at Berkeley (US) and Professor of Economics of Technology and Innovation at the University of Maastricht (NL).
- Dr. Georg Licht (German), Director of the 'Industrial Economics and International Management' department at the Centre for European Economic Research (ZEW), Mannheim (DE).
- Professor Jacques Mairesse (French), Inspecteur Général at the 'Institut National de la Statistique et des Études Économiques' (INSEE) and senior researcher at CREST and at GRECSTA (FR).
- Professor Ramon Marimon (Spanish), Director and Professor at the European University Institute in Florence (IT) and Professor at the Department of Economics and Business of Universitat Pompeu Fabra, Barcelona (ES). Former Spanish Secretary of State of Science and Technology.
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- Professor André Sapir (Belgian), Professor of International Economics and European Integration at the Université Libre de Bruxelles (BE).
- Professor Reinhilde Veugelers (Belgian), Professor of Economics at the University of Leuven (BE) and a member of the Bureau of European Policy Advisers at the European Commission

For further information contact the Group's Scientific Secretary Dr Werner Wobbe:
werner.wobbe@ec.europa.eu

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