

CONNECTING THE DOTS

How to Strengthen the EU Knowledge Economy

Fernando HERVÁS SORIANO – Fulvio MULATERO

2009

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Joint Research Centre - Institute for Prospective Technological Studies
Directorate General Research

Contact information

Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)

E-mail: jrc-ipts-secretariat@ec.europa.eu

Tel.: +34 954488318

Fax: +34 954488300

IPTS website: <http://ipts.jrc.ec.europa.eu>

JRC website: <http://www.jrc.ec.europa.eu>

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JRC55672

Luxembourg: Office for Official Publications of the European Communities

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***Summary:** The concept of Knowledge Triangle highlights the importance of jointly fostering research, education, and innovation, and of paying due attention to the linkages between them. The policy initiatives that have followed the launch of the Lisbon Strategy have correctly put a strong emphasis on progress in the research, education, and innovation areas. Greater attention should be now paid to those links between policy domains that are still missing. To move forward in this direction, governance is a crucial aspect to be improved at EU level. A new streamlined EU knowledge agenda should be put at the core of the post-2010 EU Strategy. It should rely on a more integrated R&D and innovation policy strongly connected with key relevant elements of education and training. Reinforced governance mechanisms, based on a stronger and more integrated Open Method of Coordination for research and innovation policies, will be crucial to ensure its implementation.*

Introduction

Investment in knowledge accumulation and diffusion, characterised by long-term commitments and uncertain outcomes, becomes an easy target in times of crisis. However, the enormous amount of creative destruction going on in a recession has historically been an incubator for some of the most successful innovators.¹ The 2010 Spring European Council will be the first key date in determining what will replace the current Lisbon Strategy, based upon the proposal to be made by new Commission. This will represent an ideal chance to reinforce the role of knowledge in fostering the long-term competitiveness and sustainability of the European economy.²

The overall policy objective of the Lisbon Strategy itself is the transition to a knowledge-based economy and society. While this encompassing view already implied a systemic approach, the Commission has been expressing the need to better integrate all the parts of the knowledge policy agenda for some time, noting in particular:

- *the lack of innovation and entrepreneurial culture in research and higher education*
- *a lack of investment, in particular private investment, in research and development*
- *the difficulty Europe has in translating R&D results into commercial opportunities³*

To understand how these broad policy statements could translate in terms of concrete policies and measures, both at the EU and national levels and to develop a consistent knowledge policy agenda, it is necessary to answer a preliminary question: Why, despite the official statements supporting investment in R&D, education and innovation, the objective of a knowledge-based economy and society has been attained just in part?

In this Policy Brief we will argue that further progress toward a knowledge society requires recognising that:

1. Progress in the research, education, and innovation areas has to be looked for in a synchronised way: lack of progress in one domain can hinder advances in the others too.
2. Attention must be paid to the links between the three domains above: lack of proper links between the elements of the system can render advances in a single policy domain ineffective.
3. The different degree of overlapping of institutional responsibilities at the EU and MS level, i.e. the governance of the whole process, make it even more complex to articulate adequate policy measures.

To illustrate these points, a mere increase in financial resources devoted to R&D, for example, would do little in the absence of an increase in the level and quality of education of the population and in the use of research output by innovators.⁴ This also implies that at least some objectives within each of the knowledge domains cannot be attained if addressed in isolation: while it is in principle possible for public funds for R&D to be increased at will, it is not possible to mandate increases in private ones. Even granting tax incentives to private R&D could not be enough to do the trick if other conditions are missing: lack of qualified personnel (inadequacy of the education system), costly patenting of new products (inadequacy of the innovation system), and so on.

The case for taking a wider view of this subject has been nothing but strengthened by the emerging of the internet that has radically altered the environment in which all actors are embedded, leading to the emergence of concepts such as “web of innovation”⁵. Also, the multiplication of cross-disciplinary research domains and innovations – such as bioengineering, for instance – argues for a more systemic view of the subject.

In what follows, we use the concept of Knowledge Triangle to identify the strengths and weaknesses of the current EU knowledge policy

agenda (setting of objectives and identification of measures) and to highlight the role it could play in framing the debate on the provisions for R&D, innovation and education in the follow-up to the Lisbon Strategy. The governance aspects are also examined, as they are crucial for an effective implementation of an integrated knowledge policy agenda.

What is the Knowledge Triangle and why should we care?

The knowledge triangle is a concept that refers to the integration of research, education and innovation. These three areas share an important economic feature⁶: the difference

between private and social returns. If, for instance, an innovation can be applied in a way that cannot be entirely appropriated by its creator (i.e. if so-called externalities exist), the private return to innovation will be lower than the social one. This will lead to underinvestment in innovation, creating scope for public interventions aimed at correcting this market failure.⁷ A similar reasoning holds for investments in R&D and education (see Figure 1). They are also at the center of explanations for economic growth: while knowledge and human capital exhibit decreasing returns at the firm level just like physical capital, the positive externalities they generate lead to non-decreasing returns at the economy level.⁸

Figure 1. Positive externalities within the research, education and innovation areas

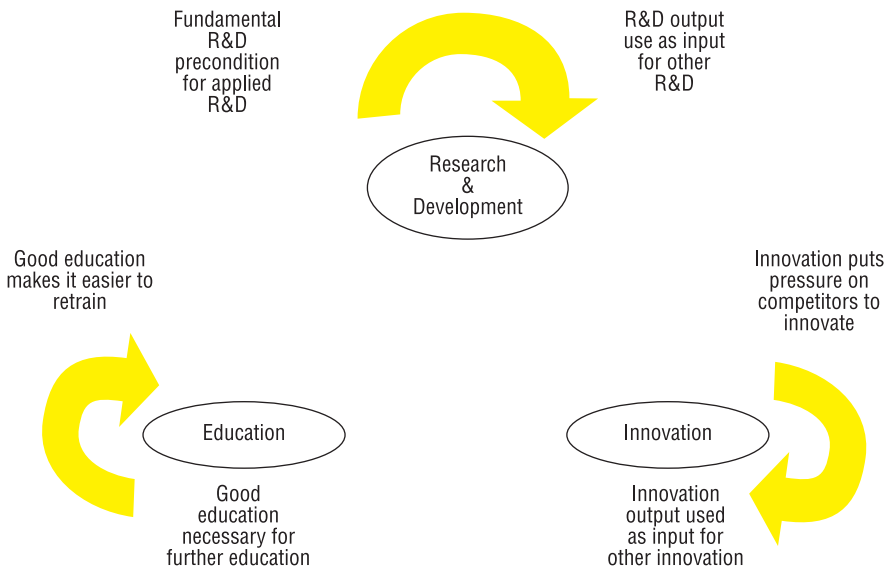
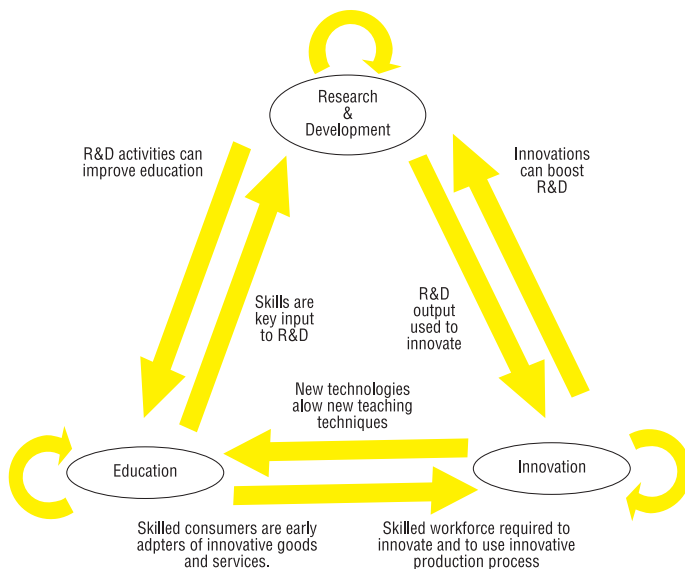


Figure 2. Positive externalities between the research, education and innovation areas



Box 1 - Good policies for a knowledge economy: Different theories with common traits

*Triple Helix*⁹

The Triple Helix denotes the relationship of university, industry and government, and also the internal transformations within each of these institutional spheres. A knowledge infrastructure is defined in terms of overlapping spheres, with hybrid organizations emerging at the interfaces. The system is perennially incomplete and in flux, the sources of innovation not fitting together in a pre-given order; the unidirectional causal relation between input and output is modified by taking into account interactions and recursivity (non-linearity of innovation).

*Innovation Ecosystems*¹⁰

There are several drivers and agents of innovation: research and invention, financial support, infrastructures, entrepreneurs, culture and education, government, society. All these elements form an innovation ecosystem and deserve attention: focusing only on some fails to yield the desired results and if one of them is dysfunctional, it can impair all the others. This implies that stimulating innovation is not straightforward and inventions by universities and other research institutions can linger for a while before yielding a commercial application. Financial services dedicated to innovative companies (such as angel investors, venture capitalists, and the like) are crucial to allow innovative entrepreneurs to overcome credit constraints. In this framework, innovation is self-reinforcing: when entrepreneurs succeed, the ensuing visibility entices other firms and more investors, thus creating a virtuous circle.

The concept of knowledge triangle goes one step beyond merely acknowledging the relevance of R&D, education and innovation: not only are these policy areas important, but there are important positive externalities *between* them. Thus, the need for improving the societal relevance of investment in these three areas calls for a systemic and continuous interaction (see Figure 2).

The interactions represented in Figure 2 are just examples and other are of course possible: for instance, innovation can induce changes in the (desired) curricula (e.g. ICT training). Progress towards a knowledge economy further benefits from other favourable framework conditions, such as well-functioning and deep capital, labour, and product markets and intellectual property rights protection.

Several concepts and theories have appeared in recent years and in several disciplinary fields, ranging from philosophy and sociology to business management, in order to depict and interpret the phenomena of knowledge creation and application (see Box 1). They all share the most important features: a focus on the non linearity of an innovation system and self-reinforcing trends, externalities leading to virtuous or vicious circles, and on the importance of not simply getting the single piecemeal policies right but also embody the linkages between them in policy action and

pay enough attention to framework conditions. The knowledge triangle is extremely convenient for policy purposes because it provides a simple but effective representation.

Links between R&D, education and innovation policies

The contribution of research to innovation is already widely acknowledged: some scientific discoveries have applications that can be turned into commercial innovation. The knowledge triangle, however, underlines the importance of considering also the reverse relation: commercial innovations can leverage research efforts by increasing their efficiency. The widespread use of new technologies (sometimes simply obtained by tinkering with off-the-shelf hardware and software) has already proved extremely successful, for instance, in life sciences, by increasing manifold the speed of DNA sequencing and thus bringing down its cost. In medical research, the use of cameras and visual recognition software to automate the screening of probes has relieved researchers from the time-consuming task of analysing Petri dishes one by one. On the policy side, while in many countries there has been an increase in the integration of research and innovation policies in recent years, the relation between R&D and innovation still seems to suffer from a unidirectional approach going from R&D to innovation.

The importance of education for research is uncontroversial: highly skilled personnel are required to perform R&D. There are currently many policy initiatives aiming at increasing the numbers of researchers and their quality. The knowledge triangle highlights the importance of paying an equal attention to the integration of cutting-edge research output into education. Despite this should in principle naturally happen within universities, the hysteresis of educational curricula (even more acute in education institutions at lower levels) can delay the uptake, leading to a slowing of knowledge accumulation.

The quantity and quality of education plays a crucial role in fostering innovation. Highly skilled workers are required to conduct innovative activities and the whole workforce can more easily adapt and exploit innovative production processes only with a good basis of education and proper training. Education is also important to create demand for innovation: highly educated consumers are indeed typical early adopters of innovative goods and services. On the policy side, some measures testify of the wish of the countries to better link (higher) education and innovation: entrepreneurship training at universities is increasingly considered and PhD education and training have received a stronger focus. It is also worth noting efforts

made to strengthen the mobility of researchers between the research sector and industry. The knowledge triangle, however, also recognises that innovations can in turn have an impact on the education system, not only by providing new techniques and media to deliver contents but also by improving the learning environment, for example through digital platforms, aimed at dealing with every aspect of university life and catering to the needs of students as well as faculty and administration. This aspect is usually only partially recognised.

To summarise, the knowledge triangle stresses the need of not treating education simply as an input within the context of human resources policies for R&D and innovation. Similarly, innovation should not be confined to the bottom of the knowledge creation process, being considered as a mere output of education and R&D activities.

Abstracting from their actual implementation (and results), some initiatives under way in many EU Member States are particularly interesting, since they address the links between the different policy areas within the policy triangle (see Box 2). For this reason, some of them would be worth discussing in more detail, namely within a new stage of the existing open methods of coordination or any new cooperation mechanisms that might be put in place for the post-2010 EU Strategy.

Box 2 – Examples of integration policies: The case of Austria.¹¹

In Austria, the ministries responsible for R&D have launched initiatives aimed at the next generation of scientists and researchers: *Sparkling Science* has the long-term objective of breaking down the barriers between school education and the science system, mainly through research collaboration between scientists and pupils; with this initiative, the Ministry for Science and Research pursues a dialogue-oriented approach to communication between science and the public.

The Ministry for Transport, Innovation and Technology (BMVIT) is responsible for the second initiative, *Forschung macht Schule*, which aims at attracting more children to a career in natural sciences and engineering, e.g. through internships in companies and research institutes, or other educational measures.

In recent years, specific measures have been designed and implemented to stimulate entrepreneurship in Austrian universities – involving all ministries responsible for R&D: the *academia+business programme (AplusB)* launched by the (BMVIT) has established support infrastructures and services at universities (AplusB-Centres) in order to help researchers starting a business and providing support services to start-up companies.

Where do we stand? The current EU knowledge agenda

The political relevance of the concept of “knowledge triangle” has been increasing since 2000.¹² Recently, Sweden has emphasised it during its presidency, first at the Lund¹³ and then at the Gothenburg conference, where the focus has been on the role of higher education institutions, as a means to reinforce the education side of the triangle.¹⁴ The concept of knowledge triangle has further been anchored in the 2020 Vision for the ERA, implying its centrality to the EU research agenda for the foreseeable future.¹⁵ Finally, the increasing demands for knowledge to be directed towards the ability to stand up to the “grand challenges” of our

times nothing but reinforce the need for an integrated approach.¹⁶

By examining how the current EU knowledge agenda is set up, it is possible to identify its main strengths and weaknesses concerning in particular the degree of interaction and coherence between the three strands of research, innovation and education. The starting point is an analysis of the current Lisbon agenda (as established after the mid-term review in 2005), namely of the relevant integrated guidelines for growth and jobs and of the Community Lisbon Programme. What follows is a synthesis of the measures included in the so-called “knowledge and innovation” priority area, plus measures related to

Table 1. The Knowledge Triangle in EU policy

	Knowledge Supply and Demand	Knowledge Circulation
Research & Development	<p>3% investment target for the EU (1/3 public and 2/3 private). Develop and strengthen centres of excellence of research institutions, create new ones and increase the number and quality of researchers. (IG 7)</p> <p>Create a genuine European Research Area (ERA) to develop a more critical mass at EU level in areas requiring large funds. (IG 7) (CLP - Objective 6)</p>	<p>Bring together public research institutions with private innovators –e.g. by developing public-private partnerships (PPPs) – to improve the cooperation and transfer of technologies. (IG 7)</p>
Innovation	<p>Improve framework conditions for innovation, in particular for venture capital and intellectual property rights. (IG 8) (CLP - Objective 7)</p> <p>Strengthen the European industrial base, focusing on the development of new technologies and markets. (IG 10)</p> <p>Promote environmental-friendly technologies within energy and climate change policies. (IG 11) (CLP - Objective 8 and 9)</p>	<p>Create and develop innovation poles, network and incubators bringing together public research institutions with private innovators. (IG 8)</p> <p>Promote new technological initiatives based on PPPs that help tackle market failures. (IG 10)</p> <p>Establish the European Institute for Technology (EIT) as a model of open innovation and knowledge sharing between public research organisations and industry.²¹ (CLP - Objective 6)</p>
Education	<p>Develop and strengthen education institutions and create new ones, attracting more students into S&T and engineering disciplines. (IG 7)</p> <p>Expand and improve investment in human capital and raise the quality of education and training. (IG 23, IG24)</p>	<p>Need of promoting a more entrepreneurial culture (IG15, IG23).</p> <p>Need for education to respond to new occupational needs, key competences and future skill requirements. (IG 24) (CLP - Objective 1)</p>

education, generally subsumed at the moment within the broad employment pillar¹⁷. The governance aspects will be examined in the next section.

Got the basics right...

When looking at the last set of Integrated Guidelines (IGs) for 2008-

2010¹⁸, the policy areas that constitute the knowledge triangle occupy a capital position: *Knowledge accumulated through investment in R&D, innovation, education and life long learning, is a key driver of long-run growth.*¹⁹ When focusing on the Community Lisbon Programme (CLP) for the same period²⁰, there is a clear recognition that *all three components of the knowledge triangle, research, innovation, and education, need to be strengthened.* Table 1 summarizes the main policy orientations foreseen by the IGs and the CLP, distinguishing between provisions that aim to strengthen the vertices of the knowledge triangle (knowledge supply and demand) and those aiming at strengthening the linkages between them (knowledge circulation).

...but now connect the dots!

The current provisions go to a large extent towards laying down the objectives to be pursued by each element of a knowledge triangle, but even greater attention should be paid to the networking of the various elements, thus avoiding a mismatch of efforts. Also, institutional arrangements, both at the EU and MS level, should be designed in such a way that bodies dealing with research, innovation and education policies properly take each other into account and avoid the pursuit of conflicting objectives.

Provisions concerning the linkages between different areas of the knowledge triangle are scattered throughout the

Integrated Guidelines. This leads to unequal coverage of linkages, with neglected areas on one side and duplication on the other side. Thus, for instance, the need to bring together public research institutions and private innovators to foster technological progress is declined three times, in three different guidelines (IG 7, 8, 10). More generally, while there are clearly identifiable attempts at bringing together the research and innovation agendas, education still seem to be dealt with mainly separately.

Also, innovation still tends to be seen exclusively as an output and education as an input, thus shorting the knowledge circuit. More positive is the acknowledgement of the importance of improving framework conditions, through well-functioning financial and product markets, to increase private spending and favour innovation. Equally, the guidelines acknowledge the importance of promoting researchers mobility to favour knowledge flows across institutions, sectors, and Member States.

As far as the CLP is concerned, the 2008-2010 programme presents a more strategic and integrated agenda compared to the one adopted in 2005 at the time of the mid-term review of the strategy. Even if this comes too late to influence the achievement of the 2010 targets, it constitutes a welcome stepping stone for the future of the Lisbon strategy. While the objectives focus mainly on research and innovation for obvious institutional

reasons, the lack of consideration of the links between different policy areas undermines consistency with the concept of knowledge triangle. Indeed, while according to Objective 1 anticipating the labour market needs of a knowledge-based economy is clearly part of the agenda, no explicit reference is made to the contribution expected from education to an integrated knowledge agenda.

Finally, quite confusing is the fact that “knowledge” seems to be used as a synonym for – and to have replaced in some formulations – “research”, and be discussed separately from innovation. As a consequence, these two areas end up being treated almost independently, albeit with some overlapping, thus undermining attempts of an integrated approach.

The key role of governance

An integrated governance of the EU knowledge agenda is in part ensured by the governance structures of the Lisbon strategy, namely the role of the European Council and the decisions taken annually during the Spring meetings, including country-specific recommendations based on the annual assessments made by the Commission on the degree of progress of Member States’ National Reform Programmes (NRP) as well as the agreement on the main priority areas for action and key measures at EU level. While this has helped bring coherence to the agenda, given the way decisions

are taken at the Council – based on bottom-up building consensus from the 3 main sectoral Council formations involved (Competitiveness – channelling also input from other groups like environment and regional policy –, Employment and ECOFIN) – the degree of integration is limited. The Commission, which plays an important role proposing both the IG and the CLP, monitoring their implementation and assessing Member States NRP’s, faces similar limitations that arise from its internal governance structure.

It is therefore important for governance at a lower level to allow for effective integration of the three sides of the triangle. A concrete framework has already been established in the area of education: in May 2009, Member States have agreed on a new strategic framework (“ET 2020”) including a reference to the knowledge triangle, common strategic objectives, a series of benchmarks linked to them, areas where further work is needed to identify new benchmarks and concrete priority areas for the first three-years cycle (2009-2011).

Member States’ cooperation in this area is a good example of effective application of the open method of coordination (OMC) that could inspire the areas of research and innovation, where the importance of improving governance has been recognised as a key priority but concrete actions still have to

follow. Current discussions focus on the need to:

- reinforce the political nature and role of the current CREST OMC;
- clarify and simplify the current instruments (“toolbox”) by, among others, better aligning each instrument to concrete policy objectives;
- develop indicators that capture progress towards the ERA objectives;

in the field of research and, for innovation, to:

- further strengthen the knowledge triangle between business, education and research²²;
- improve synergies between different governance levels (EU, national and regional);
- simplify and streamline current EU financial support instruments.

In all cases, the need to strengthen the interaction between the three policy areas is recognised as an important challenge in the context of the post-2010 EU Strategy.

The EIT and the establishment of the first Knowledge and Innovation Communities (KICs) is an important initiative, since the KICs should help identifying new governance models to implement the knowledge triangle on the ground. However, a truly integrated “knowledge agenda” will still be needed and specific governance instruments should be set to ensure its implementation and monitoring. This agenda should

include a number of concrete EU strategic objectives, supported by adequate indicators and, if appropriate, common benchmarks and targets.

Within Member States, the recent increase in the coordination of research policies constitutes an important step forward. In this area, Member States tend to follow two basic models, namely the coordination by advisory councils / chief advisers and the coordination through central ministerial or inter-ministerial boards (with weak advisory bodies).²³ To foster further integration of all the policy areas of the knowledge triangle, this coordination should be extended to encompass innovation (as is the case already in some countries) and education policies. This would also make it easier to spot which framework conditions are found wanting and should thus be reinforced.

Conclusions

For any new post-2010 EU strategy knowledge will have to occupy a central role²⁴. At the same time, the assessments of the three policy components of the knowledge triangle highlighted the need for more coherence and interaction between the three agendas. It emerges that:

1. **Emphasis has been correctly put on progress in the research, education, and innovation areas.** The current provisions

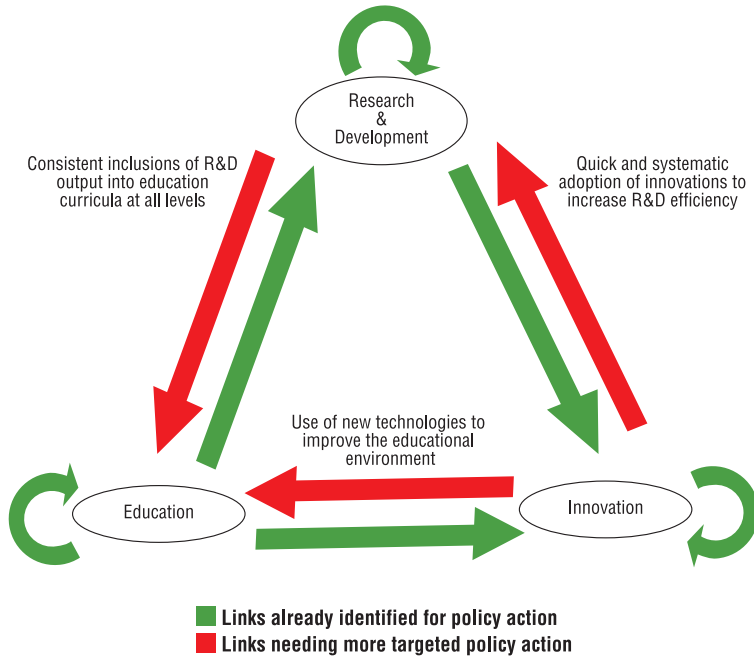
address the need to strengthen each element that constitutes the vertices of the knowledge triangle (research, education and innovation). This is not to say that within the research, education, and innovation areas there is nothing else to be done, or that efforts will be easily scaled up (witness the difficulties encountered in attaining the 3% target for R&D).

- 2. Greater attention should be paid to the missing links between policy domains.** Lack of proper links between the elements of the knowledge system can neutralise advances within a single policy domain. As underlined by Commissioner Potočník, it is now important to see where and how we can improve the interactions between the three triangle points and make the whole structure stronger.²⁵ Due attention should be paid to two-way relations between policy areas: progress towards a knowledge society requires devoting the necessary attention to the interactions between the vertices of the knowledge triangle (the edges). This is as important as having strong corners, if not more, because of externalities, multiplier effects and self-reinforcing dynamics. Figure 3 depicts in a stylised way the current state of EU policies within the knowledge area, highlighting the areas already addressed by policy initiatives (in

green) and those that will need to be reinforced (in red).

- 3. A new streamlined EU knowledge agenda should be put at the core of the post-2010 EU Strategy.** It should rely on even more integrated R&D and innovation policies, in turn strongly connected with key relevant elements of education and training (currently mainly addressed in isolation). It should rely on a limited number of headline objectives, common for the three sides of the triangle. The concrete measures and instruments devised to implement this agenda should be linked to such common broad objectives. Any possibility to better integrate current and future EU supporting measures should be exploited, promoting for example cross-cutting programmes. The experience drawn from the EIT's first Knowledge and Innovation Communities and from successful Member States initiatives should help to design new instruments.
- 4. Improved governance mechanisms will be crucial to ensure implementation of the new knowledge agenda.** The need of stronger cooperation mechanisms between Member States and the Commission to implement the European Research Area is recognised at ministerial level, where the future role of CREST is being discussed. In this context, a reinforced open method of

■ Figure 3. Weak links of knowledge policies



coordination responsible for implementing the proposed research and innovation streamlined agenda should be seriously considered. Such an OMC should directly report to the Competitiveness Council, its principal mandate being the provision of policy orientations to be fed into the governance of the EU Strategy.

In order to complete the governance structure, adequate coordination mechanisms between

the new reinforced OMC for research and innovation and the OMC for education and training should be established. Such mechanisms could include the organisation of specific working groups to cover main relevant areas such as: implementation of the European Higher Education Area, the identification of new skills for new jobs in a knowledge economy or lifelong learning strategies in knowledge intensive societies.

Endnotes

- 1 See “Thriving on adversity”, *The Economist*, October 1st 2009.
- 2 As remarked by President Barroso, differently from the US and despite recent efforts, European research remains fragmented. See José Manuel Barroso, *Political Guidelines for the Next Commission*.
- 3 Frequently Asked Questions: Why does the EU need a European Institute of Technology? MEMO/06/88, 22/02/2006.
- 4 This point is generally acknowledged by official documents (such as the Integrated Guidelines) and commentators. Thus, for instance, the proposal of jointly considering an objective of 5% of GDP for expenditures in R&D and education by 2014. See Bruno Van Pottelsberghe (2009), *The Commissioner for Knowledge*. In André Sapir (Ed.) *Memos to the new Commission*, Bruegel.
- 5 See Alexander Loudon’s “Webs of Innovation: The Networked Economy Demands New Ways to Innovate”, Pearson Education.
- 6 For a comprehensive treatment of the topics discussed in this section, see Barro, Robert and Sala-i-Martin, Xavier (2003), *Economic Growth*, 2nd Ed., MIT Press.
- 7 Private investments need not necessarily be below the socially desirable level: the so-called *dotcom bubble*, which led to widespread overinvestment in ICT technologies, provides an interesting counterexample.
- 8 This also implies that convergence between countries can no longer be taken for granted. This theoretical argument has gained relevance for the EU following the increase in heterogeneity of its Member States. See Veugeler, Reinhilde and Mrak, Mojmir (2009), *The Knowledge Economy and Catching-up Member States of the European Union*, Report prepared for Commissioner’s Potocnik’s Expert Group “Knowledge for Growth”. Also, investment in knowledge has grown at a greater rate than the one for investment in physical capital since the mid-1990 in most OECD countries. See Bosworth, Derek (2009). *The R&D, knowledge, innovation triangle: education and economic performance*. Mimeo.
- 9 See Leyersdorff - Etzkowitz’s “A Triple Helix of University – Industry – Government Relations”: “Mode 2” and the Globalization of “National” Systems of Innovation.”
- 10 See, for instance, Bill Aulet (2008) “How to Build a Successful Innovation Ecosystem”. MIT Sloan and CRECE (2005). *Science and companies: Towards a dynamic ecosystem for innovation in Spain*. Confederacion de Sociedades Cientificas de España.
- 11 In Box 2 we focus on models of coordination between policies, based upon information available in the Erawatch repository. See <http://cordis.europa.eu/erawatch/>.
- 12 Several policy documents have also helped raising the awareness with respect to the importance of properly linking the different policy areas of knowledge systems; see, for instance, the discussion on the “crucial nodes and components” in: European Commission (2002). *The Impact of RTD on Competitiveness and Employment (IRCE)*. A STRATA-ETAN Expert Group.
- 13 See The Lund Declaration, “Europe must focus on the grand challenges of our time”, July 2009.
- 14 See Context of the Conference, “The Knowledge Triangle Shaping the Future of Europe”, Gothenburg, 31 August to 2 September 2009: *The importance of a well-functioning knowledge triangle (education-research-innovation) has been underlined by the European Council at every summit on the Lisbon strategy since 2006. Universities are at the heart of the knowledge triangle and at the interface between the European Higher*

Education Area (EHEA), the European Research Area (ERA) and the European Innovation Area (EIA). These institutions play indeed a crucial role not only due to their traditional mission of creating and disseminating knowledge, but also by linking education, research and innovation through collaboration with the wider community. See also: Conference Conclusions, “The Knowledge Triangle Shaping the Future of Europe”, Gothenburg, 31 August to 2 September 2009.

- 15 See Council of the European Union (2008). 2020 Vision for the European Research Area: *The modernisation of research, education and innovation systems go hand in hand. Strong interactions within the “knowledge triangle” (education, research and innovation) are promoted at all levels, from individual researchers, funding organisations, universities and research institutions to SMEs and multinational companies, and are supported by appropriate European mechanisms. Research, education and innovation policies and programmes are jointly designed among public authorities at all levels with appropriate involvement of relevant stakeholders, whenever this is necessary to optimise their effectiveness, efficiency and value to society and the economy.*
- 16 Grand challenges can be defined as societal *problems that cannot be solved in reasonable time and/or with acceptable social conditions, without a strong and, in the European case, coordinated input requiring both technological and non-technological innovation, and also, but not necessarily always, advances in scientific understanding.* See “The Role of Community Research Policy in the Knowledge-Based Economy”, Report of an Expert Group to the European Commission, Chapter 2, October 31st 2009.
- 17 Education, together with training, is indeed usually addressed in more detail separately. See, for instance, European Commission, An updated strategic framework for European cooperation in education and training, COM(2008) 865 final. *To ensure a fully functioning knowledge triangle of education-research-innovation is indeed explicitly identified as a strategic challenge for education and training policy.*
- 18 European Commission, Integrated Guidelines for Growth and Jobs (2008-2010), COM(2007) 803 final PART V.
- 19 Policy orientations on research and innovation are included in the microeconomic section of the guidelines, in chapter B.1 “Knowledge and Innovation – engines of sustainable growth”. As for education, orientations are included in chapter 3 of the employment guidelines, “Increase investment in human capital through better education and skills”.
- 20 European Commission (2007), Proposal for a Community Lisbon Programme 2008-2010. COM(2007) 804 final. The 2008 Communications on the implementation report of this programme and the European Economic Recovery Plan have also been considered as they bring some additional elements. See COM(2008)881 of 16.12.2008 and COM(2008)800 of 26.11.2008.
- 21 In this respect, the Commission put forward a recommendation on knowledge transfer and a code of practice for IP management in universities and public research centres.
- 22 “Reviewing Community innovation policy in a changing world”, COM (2009) 442 of 02.09.2009
- 23 In some cases, these mechanisms are accompanied and supported by strategic plans and documents. Also, in several countries R&D policies overlap partially with those carried out within other ministerial portfolios, such as transportation, agriculture, energy, health, and telecommunications. For a comprehensive review, see Veltri, Giuseppe; Grablowitz, Alexander and Mulatero, Fulvio (2009). Trends in R&D policies for a European knowledge-based economy. JRC Scientific and Technical Reports series.
- 24 See “National Lisbon Coordinators discuss future of Lisbon Strategy in Prague”, Press release, 22.04.2009, available at <http://www.eu2009.cz/en/news-and-documents/press-releases/lisbon-en-18064/>
- 25 Janez Potočnik, The significance of the knowledge triangle for the future of Europe, SPEECH/09/, Gothenburg, 1st September 2009.



European Commission
Joint Research Centre
Institute for Prospective Technological Studies

Contact information

Address: Edificio Expo. c/ Inca Garcilaso, 3
E-41092 Sevilla (Spain)
Tel.: +34 954488318
Fax: +34 954488300
E-mail: jrc-ipts-secretaria@ec.europa.eu
More information: <http://ipts.irc.ec.europa.eu>

