Science of the Total Environment 481 (2014) 668–673

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Technological innovation, human capital and social change for sustainability. Lessons learnt from the Industrial Technologies Theme of the EU's Research Framework Programme

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HIGHLIGHTS

- The EU's strategy focuses on competitiveness and sustainability. R&D plays a critical role.
- The EU industry is challenged by the disconnection of knowledge creation and production.
- Human capital, a core EU competitive advantage, is challenged by current reforms.
- Innovation needs educating on cooperation and creativity, instead of standardisation.
- A sustainable society requires a social change and, therefore, social innovation.

ARTICLE INFO

Article history:
Received 27 June 2012
Received in revised form 21 September 2013
Accepted 25 September 2013
Available online 19 October 2013

Editor: Christian Ludwig

Keywords:
Research
Industry
Environment
Technology
Education
Social innovation

ABSTRACT

Europe is facing a twofold challenge. It must maintain or even increase its competitiveness, a basic requirement in a globalised economy and under the current demographic threat. It needs also to tackle the so-called "grand challenges", especially environmental issues, through a sustainable model of production and consumption. Such challenges should lead to new business and industrial models, based on more sustainable production and consumption chains, from design to end of life. This implies a need for new industrial materials and processes, new skills and, indeed, new values and life-styles. Sustainability and innovation are key elements of EU's Research and Innovation Framework Programmes, particularly in the field of industrial technologies (nanotechnologies, materials and industrial technologies), which objective is to "improve the competitiveness of the European industry and generate knowledge to ensure its transformation from a resource intensive to a knowledge intensive industry". Sustainability and innovation are interrelated challenges for R&D. Research can develop technical solutions to tackle environmental or societal challenges, but such technologies need to be successfully commercialised to have a real environmental impact. Several socio-economic studies carried-out by the European Commission show not only the emerging technological and industrial trends, but they also emphasise the need for linking sustainable technologies with social change. Human capital and new social behaviours are critical factors to combine economic competitiveness and sustainability: technology alone is no longer able to solve global challenges. But what kind of human capital (skills, behaviours, and values) are we referring to? How to encourage the shift towards a greener society through human capital? Which reforms are needed in education systems to move towards a sustainable economy? Are there examples of social innovation to be extrapolated and/or generalised?

1. Introduction

"The times they are a-changin'".

Almost half a century after he composed his classical song, Bob Dylan could add an adjective to the refrain: "fast" or "quickly". He may even say "too fast" or "too quickly". It is becoming difficult to remember historical events that happened recently: Tunisian and Egyptian Revolutions, nuclear crisis in Japan, Libyan civil war, *Escherichia coli* food crisis, killing of Bin Laden….

In parallel to such spectacular events, other radical changes are ongoing, even if they do not appear in the cover pages of newspapers and magazines. The World is evolving at a speed without precedents. We are increasingly conscious about the so-called "grand societal challenges", in particular environmental issues (e.g. climate change, environmental degradation, scarcity of food, energy and raw materials).

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http://dx.doi.org/10.1016/j.scitotenv.2013.09.082

Such consciousness is particularly high in Europe…. But Europe is losing its momentum. It is becoming a secondary player in the World, politically and economically (European Commission, 2010a).

The European Commission makes a similar diagnosis in its official strategic documents, even if they do not explicitly recognize the European decline. This clearly appears in the Europe 2020 Communication (COM (2010) 2020), which underlines three interrelated challenges:

- Europe must maintain or even increase its competitiveness, as a basic requirement in the globalised economy and under the current demographic threat (i.e. ageing population).
- It must tackle the societal challenges, in particular those related to environment (e.g. climate change, environmental degradation), through a sustainable model of production and consumption.
- Europe must reinforce social and territorial cohesion.

In this EU's "smart, sustainable and inclusive growth" strategy, research and innovation play a critical role. The flagship initiative "Innovation Union" clearly underlines that "perhaps the biggest challenge for the EU and its Member States is to adopt a much more strategic approach to innovation. An approach whereby innovation is the overarching policy objective, where we take a medium- to longer-term perspective, where all policy instruments, measures and funding are designed to contribute to innovation (…)" (SEC (2010) 1161). In other words, to maintain its competitiveness, Europe must ensure a *continuum* between research and innovation.

These ideas are not new. The "Lisbon Strategy" was already aimed at making the European Union (EU) "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion" by 2010 (Lisbon European Council, 2000). Indeed, several years ago, in 1997, the European Commission published its "First Action Plan for Innovation in Europe", with the goal of putting "innovation at the service of growth and employment", in particular through a "better articulation of research and innovation" (European Commission, 1997).

Is the European Union just repeating the same concepts in a rapidly changing World? Is the "knowledge-based economy" model a realistic objective for Europe or just political slogan?

This paper tries to analyse critically the results, weaknesses and challenges of the EU's action on research in the field of industrial technologies. Why industrial technologies? There are two main reasons to select this area. First of all, industrial technologies[1] are part of the "Key Enabling Technologies" that "will be at the forefront of managing the shift to a low carbon, knowledge-based economy" (COM (2009) 512/3). Therefore, they should play a critical role in an expected economic transition.

Secondly, the European industry lives a paradox. On the one hand, delocalisation shows that the traditional European manufacturing can hardly compete with low wages countries like China but, on the other hand, the current crisis indicates that industrial economies like Germany are stronger and more resistant than services or construction-based ones (Beck and Scherrer, 2010; Deutsche Bank Research, 2011). This alerts about the still relevant role of industry in European economy.

The European industry has a chance to compete with emerging low-wages economies through high added-value products and services: new materials, new processes and new services linked to products. This also means *new business and industrial models*, based on more sustainable production–consumption chain (from design to end of life, comprising physical production, sources of energy, maintenance of products, recycling, etc.) and, together with innovative new materials and processes, also new skills and probably new values and life-styles.

Accountability look counterproductive compared with those focusing on soft skills like cooperation and creativity.

* These are indeed competences and behaviours more consistent with a sustainable society than the current consumerist, market-oriented paradigm. The myth of technologically-supported unlimited growth is over. A sustainable society requires social change and, therefore, social innovation. The current crisis could be an opportunity for this.

2. The EU's Framework Programme on research and industrial technologies

Sustainability and, increasingly, innovation are key elements of European Union's Research Framework Programmes (FP). Environment is part of the Framework Programmes since the very beginning, when FP1 was launched in 1984. Since then, funding for environmental research has constantly increased, managed through specific sub-programmes (European Commission, 2012). Sustainable issues are also integrated in other R&D areas funded by the EU. In parallel, innovation is a key leitmotiv of EU funding, at least since FP6 (2002–2006) but more explicitly with FP7 (2007–2013).

This combination of sustainability and innovation appears very clearly in the field of industrial technologies, which objective is to "improve the competitiveness of European industry and generate knowledge to ensure its transformation from a resource-intensive to a knowledge-intensive industry" (COM (2009) 512/3).

In fact, sustainability and innovation are two interrelated challenges for R&D. Research can develop technical solutions to tackle environmental or societal challenges (e.g. technologies to reduce CO_2 emissions, to be more energy-efficient, to replace scarce raw materials), but to be environmentally effective, technologies must be successfully commercialised.

The EU funding under FP6 (2002–2006) to industrial technologies amounted EUR 1,534,240,630. The Commission signed 444 collaborative contracts, with participation of 6018 organisations. The NMP budget represented 9.2% of total EU's contribution. For the ongoing FP7 (2007–2013), the EU Member States earmarked a total of EUR 3.5 billion for funding the industrial technologies/NMP theme.

The Commission has launched several evaluation and impact assessment studies to analyse added-value of its intervention in the field of NMP. For instance, the Ex Post Evaluation of FP6 (NMP) at strategic level (Oxford Research and KMFA, 2010)[2] shows that:

- FP6 was a success in scientific terms, especially when compared with the European Research Area (ERA) objectives. The benefits of FP6 include network building, better access to international knowledge, creation of sustainable international relationships for research and the possibility to work in bigger and international consortia towards more ambitious goals. Data shows that EU funding allows participants to launch R&D projects that other (national or regional) funds cannot create: Bigger scale of projects, cooperation between international actors, and higher technological ambition. FP is definitely contributing to the scientific advancement of industrial technologies in Europe, creating new knowledge in areas like nanomedicine, forestry, energy, electronics, textiles, machine tools and robotics. The number of peer-reviewed publications is impressive: on average, 55 per project under FP6 (INNO AG-Atlantis, 2011)!
- Economic impacts were not the priority under FP6, compared with knowledge creation. Nevertheless, nearly half of the project coordinators in NMP FP6 claimed they produced an innovation related output, such as process innovations, product innovations or patents/licences. An evolution towards innovation appeared in the last period of FP6 and, more clearly, under FP7, both in terms of programme definition (industry-driven agenda) and results (highest share of participation of private for profit organisations and positive statistics on commercial returns, patents and spin-offs).

[1] Industrial technologies, in the EU jargon, cover Nanosciences and Nanotechnologies, Materials and new Production technologies (NMP). It is one of the ten thematic priorities of the European Union's Seventh Framework Programme (FP7) on Research, within the specific programme "Cooperation".

[2] An ex post evaluation of FP7 is going to be carried out in 2014. FP7 data presented here are just preliminary, coming from monitoring actions.