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IMPACT ASSESSMENT

Accompanying the

Communication from the Commission 'Horizon 2020 - The Framework Programme for Research and Innovation';

Proposal for a Regulation of the European Parliament and of the Council establishing Horizon 2020 – the Framework Programme for Research and Innovation (2014-2020);

Proposal for a Council Decision establishing the Specific Programme implementing Horizon 2020 – The Framework Programme for Research and Innovation (2014-2020);

Proposal for a Council Regulation on the Research and Training Programme of the European Atomic Energy Community (2014-2018) complementing the Horizon 2020 – The Framework Programme for Research and Innovation

Annexes

Annex 2:The Need for Public Intervention and European Added Value

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ANNEX 2: THE NEED FOR PUBLIC INTERVENTION AND EUROPEAN ADDED VALUE

PUBLIC INTERVENTION IN RESEARCH AND INNOVATION IS JUSTIFIED BY MARKET AND SYSTEMIC FAILURES

- The right balance between public and private investment should be struck on the basis of a careful assessment of the presence of market and/or systemic failures that government should address.
- Research is seriously affected by **market failures**, as a result of which there is significant private sector underinvestment in research and a solid basis for public support:
  - A first market failure concerns **risk and uncertainty**. At the start of a research project, it is not at all sure that the research efforts undertaken will actually result in new knowledge and innovation. The challenge of risk and uncertainty is exacerbated by the fact that the cost of R&D is rising, because it becomes more expensive to carry out research and because the life-cycle of products is shortening dramatically (for more on costs of research, see Box hereafter). Levels of risk and uncertainty are especially high when developing the breakthrough technologies required by new techno-economic paradigms, in other words when engaging in radical rather than incremental innovation. A related point is that market prices do not take full account of negative externalities (e.g. polluting activities). As long as markets do not punish environmentally harmful impacts or reward environmental improvements, competition between environmental and non-environmental innovation is distorted and a socially sub-optimal amount of investment occurs.

Striking results of a recent EU survey on Cost of Research

A recent EU survey on "costs of research" has been conducted among 200 R&D intensive private companies and public research organisations equalling over 115,100 R&D employees (or 112,520 FTE) in Europe's ICT, pharmaceutical, chemical, and automotive sector. The results of the survey methodology have been cross-checked in 37 in-depth case-studies entailing over 50 personal interviews with R&D managers.

The surveyed companies unanimously judge R&D labour costs to be by far the largest cost component of undertaking R&D (50%), followed by capital costs (such as ICT, machines, infrastructures, 17%) and purchased R&D (14%). Although relocation intensities differ per sector, surveyed companies strikingly agree that relocating abroad is not an important action to reduce R&D costs; it is part of a bigger strategic decision to be closer to a particular market in order to adapt products to local demand and tap into local (R&D) expertise.

R&D labour costs is not only the largest cost component of R&D, it is also the cost factor most difficult to contain as it is governed by a global demand offering globally comparable wages. As one manager put it "one has to pay the salaries and one has to provide the infrastructure and equipment, otherwise it is impossible to attract excellent researchers in our industry", a trend most likely to continue in the future.

The activities considered by the surveyed companies to be most important in bringing down the cost of research, are:

- ✓ aligning R&D with business strategies,
- ✓ joining collaborative R&D projects, and
- ✓ technological efficiency of the R&D process.

The activities considered by the surveyed companies to be most influential in driving up the cost of research, are:

- ✓ complexity of the R&D process,
- ✓ environmental legislation, and
- ✓ regulation of product markets.

To the question whether the cost of research has increased in the past five years, surveyed firms reported an increase of 47% in R&D expenditures or total R&D costs over the last five years. Thereby, 87% of companies report that this growth is primarily based on an increase of the volume of R&D, while the 13% said that it is due to rising prices.

To the question whether the cost of research will continue to increase in the next 5 years, the companies reported to expect an increase of 30% on average. Given that the major cost component is R&D labour, costs of research in the longer term (20 years) are unlikely to fall in relative terms.

Source: COST, 2011

  - Companies may be reluctant to invest in research out of fear that the new products they may come up with may make **obsolete** the products they are currently deriving substantial profits from. Such rigidity, such path dependency, prevents investment in radical innovations that can revolutionise markets and produce huge social benefits.

  - Another market failure results from the fact that, even if the research initiative gives rise to new knowledge and innovation, it is not at all sure that the researcher or company that has undertaken the research efforts will be able to exclusively **appropriate** all the benefits deriving from it.
  - The appropriation problem is exacerbated in the case of public goods and paradigm shifts.
    - Companies are reluctant to invest in research on **public goods**. Examples of public goods are clean air, clean drinking water, health, etc. The social benefits of research on public goods exceed the possible private gains to be derived from it, which leads to private underinvestment in research. A good example in this respect is the fact that private pharmaceutical companies carry out comparatively little research on the development of vaccines for diseases such as malaria, tuberculosis, and African strains of HIV. Another good example concerns eco-innovation, which produces positive externalities in the form of positive environmental effects for which the eco-innovator is not fully "rewarded".
    - Companies are also reluctant to invest in research for which as yet there is no immediate pay-off because no market exists yet or a market exists that is not yet fully developed. This is often the case for **paradigm-shifting** breakthrough technologies, e.g. environmental technologies, hydrogen, nuclear fusion, etc. In such cases, public support is essential not only to support research but also to "make" a market through public procurement, the provision of incentives to consumers, investment in accompanying infrastructure, etc.
- The need for public support of research also derives from the **system** nature of innovation, and from the importance to invest in human capital and networks to ensure the absorption of knowledge.
  - The innovation systems literature argues that what matters for an economy's innovation performance are the **linkages** and flows of information between the different actors in the innovation system. These linkages and flows are often sub-optimal and government can play a role in strengthening them.
  - As argued above, the dissemination, valorisation and economy-wide **market take-up** of new technologies is an issue of a systemic nature. For instance, electric cars will not be used on a large scale if electric vehicle refuelling points are not widely available. The public sector often has to take the lead in addressing such systemic obstacles to technology uptake. Another good example concerns eco-innovation, which does not concern a single sector in conventional terms but a range of technologies, products, services, business models, and potential target markets. This makes it more difficult for potential investors to evaluate funding opportunities and asses risks than if all investment opportunities were built around a common technology platform. This is especially the case in sub-sectors, such as those not related to energy, which are less known or considered immature and therefore riskier.

PUBLIC INTERVENTION IN RESEARCH AND INNOVATION PRODUCES CLEAR BENEFITS

Public research generates direct economic benefits

- It is a source of useful new information and knowledge (Martin et al., 1996, vii; CaSE, 2009).
- It creates new instrumentation and methodologies (Martin et al., 1996, vii).
- Those engaged in basic research develop skills which yield economic benefits when individuals move from basic research carrying codified and tacit knowledge (Martin et al., 1996, vii). Highly skilled scientists and engineers are one of the most predictable and rapid outputs of the research base and one that is highly prized by industry. They carry with them tacit knowledge - skills and experience - which in turn creates impacts in public or private research and is highly-valued in other sectors too (CaSE, 2009). Alongside new knowledge, universities working at the research frontier have a second core 'product', namely highly trained people, an essential resource for UK companies and foreign companies investing in the UK. Both outputs are essential for sustaining and improving the country’s economic performance (RCUK).
- Through participation in basic research, access is granted to networks of experts and information (Martin et al., 1996, vii).

- Those trained in basic research may be good at solving complex technological problems (Martin et al., 1996, vii).
- And, finally, on the basis of basic research, spin-off companies are created (Martin et al., 1996, vii). From 2003 to 2007, 31 university spin outs were floated on stock exchanges with an IPO value of £1.5 bn and 10 spin outs were bought for a total of £1.9 bn (CaSE, 2010). Universities also encourage innovation by smaller local businesses and, through incubators and science parks, the emergence of new companies (RCUK). University research has led to the development of many innovations that have been commercialised either through licensing to private companies or the formation of new start-up companies. This 'technology transfer' activity has been particularly intense in the United States since the Bayh-Dole Act in 1980. This piece of legislation not only gave universities the right to patent new discoveries but also mandated them to license inventions made with federally sponsored research to the private sector. Now, nearly all US research universities have a technology licensing office and explicit intellectual property policies and royalty-sharing arrangements for their scientists. Between 1991 and 2000, the number of licenses on university inventions in the United States increased from 1,278 to 4,362, and licensing income rose from $186 million to $1.3 billion. Licensing and star t-ups based on university innovations are increasing in Europe too, with the UK taking the lead (RCUK).

Public research increases the pay-off to private R&D and supports innovation

- US research estimates that a 10 per cent increase in university R&D increases corporate patenting by between 1 per cent and 4 per cent (Jaffe, 1989; Jaffe and Trajtenberg, 2002) (quoted in RCUK).
- 15 % of new products and 11 % of new processes would have been developed with a substantial delay in the absence of academic research (Mansfield, 1998).
- Approximately 20% of private sector innovations are partially based on public sector research (Tijssen, 2002).
- Cohen, Nelson and Walsh (2002) evaluated for the US manufacturing sector the influence of public (i.e. university and government R&D laboratory) research on industrial R&D, the role that public research plays in industrial R&D, and the pathways through which that effect is exercised. They found that public research is critical to industrial R&D in a small number of industries and importantly affects industrial R&D across much of the manufacturing sector. Public research both suggests new R&D projects and contributes to the completion of existing projects in roughly equal measure overall. Key channels through which university research impacts industrial R&D include published papers and reports, public conferences and meetings, informal information exchange, and consulting.
- A stochastic frontier analysis by the European Commission's Directorate-General Economic and Financial Affairs found significant positive effects on the number of patents and business patents per million inhabitants for a number of independent variables related to public intervention: the public R&D stock, international research cooperation and international researcher mobility (through which access is provided to the stock of foreign R&D), and the share of R&D invested in basic research (Mandl et al., 2008).

High-quality public research attracts private R&D

- Belderbos et al. (2009) found that, controlling for a wide range of host country factors, the number of relevant ISI publications by scientists based in the host country has a substantial positive impact on the propensity to conduct foreign R&D. The effect of academic research is significantly larger for firms with a stronger science orientation in R&D - as indicated by citations to scientific literature in prior patents;
- Doh et al. (sd) found that US MNC R&D location decisions, and the relative levels of R&D investment in a given country location, are mostly influenced by broad, macroeconomic and development factors. Scientific output, and to a lesser extent, institutional quality, appropriability regimes, and telecommunications infrastructure, also influence R&D location, while the presence of existing MNC investment is not found to influence R&D investment.
- Dosi, Llerena and Sylos Labini (2009) presented cross-country comparisons revealing that industry-financed R&D is positively associated with both the per capita number of highly cited researchers and expenditure on higher education R&D. This also held within sectors: in a number of industrial sectors,

R&D intensity was positively correlated with the quality of academic research in selected related fields, and those countries with the highest per capita number of highly cited scientists in relevant fields displayed the highest R&D intensities.

- Guimon (2008) found that the empirical evidence available suggests that, among the factors related to the host country, the main location drivers for R&D-intensive foreign direct investment are the availability of world-class research infrastructure and skilled labour as well as the dynamism of the national innovation system, that is, the degree of interaction and collaboration among different firms and other "knowledge producing and diffusing organizations" (universities and research centres, consultants, industrial associations, etc.).
- Abramovsky, Harrison and Simpson (2007) (quoted in RCUK) investigated the relationship between the location of private sector R&D labs and university research departments in Great Britain. They combined establishment-level data on R&D activity with information on levels and changes in research quality. The strongest evidence for co-location was found for pharmaceuticals R&D but also for other sectors evidence for co-location was found. There is evidence that private sector R&D labs in the UK are disproportionately clustered around highly rated university research departments. This phenomenon is not driven just by university 'spin-outs': in some industries, foreign-owned companies are choosing to locate in close proximity to high quality research. This implies that multinational companies may be sourcing cutting-edge technologies from universities in the UK. The results of this study show that R&D facilities 'cluster' near university departments, particularly in the pharmaceuticals and chemicals sectors. A postcode area (for example, ‘OX’ for Oxford) with a chemistry department rated 5 or 5* by the 2001 RAE is likely to have around twice as many labs doing R&D in pharmaceuticals and around three times as many foreign-owned pharmaceuticals R&D labs compared with a postcode area with no 5 or 5* rated chemistry departments.
- Research also finds evidence that foreign-owned labs in the machinery and aerospace sectors are likely to be located near to materials science and electrical engineering departments rated 4 or below by the RAE (Abramovsky and Simpson, 2008) (quoted in RCUK). This suggests that companies also benefit from proximity to more applied, commercially oriented research activity.
- A recent study analyses the relationship between the number of patenting manufacturing firms and the quantity and quality of relevant university research across UK postcode areas (Helmers and Rogers, 2010) (quoted in RCUK). It finds that different measures of research 'power' and 'quality' positively affect the patenting of small firms within the same postcode area. This indicates that small firms benefit from localised university-industry knowledge transfer.
- A further study of research and local development examines the impact of university business incubators on innovation by firms close by (Helmers, 2010) (quoted in RCUK). Standard business incubators provide start-up companies with a range of support measures, including physical space within the incubator building, training and coaching, business contacts, access to finance, etc. University incubators have the additional advantage that they can draw on the resources available at the university, including academic support, access to research facilities, as well as easy access to the student pool to recruit employees. The study finds that the recent wave of establishment of new university business incubators in the UK has generated local externalities by increasing the patenting propensity of incumbent firms located geographically close to the new university business incubators. Incumbent firms react to the entry of new firms within the same sector by increasing their propensity to patent by 2-6 per cent. The effect is stronger the closer the entrant is geographically located to an incumbent – the strongest impact occurs within a radius of 5-15 kilometres. Beyond 100 kilometres, entry has no economically significant effect on incumbent patenting.
- Recent research on knowledge spillovers from university innovation in the United States confirms that, for companies to use publicly funded research most effectively, geographical location has a significant contribution (Belenzon and Schankerman, 2010) (quoted in RCUK). Analysing patent citations both to university patents and scientific publications, the study finds that knowledge spillovers are strongly localised, sensitive to distances of up to 15 miles. Companies located in the same state as the cited university are substantially more likely to cite one of the university patents than a company located outside the state.

Public subsidies for private research increase the total amount of research expenditure (input additionality, crowding-in effect, leverage effect)

- Most recent studies find positive effects of R&D subsidies on R&D investment (Czarnitzki, 2011).
- €1 of public funding for R&D (including defence) leads to additional business R&D of €0.70-0.93 when allocated to business (Guellec and Van Pottelsberghe, 2000; European Commission, 2004).
- A 10 per cent increase in university research increases private R&D by 7 per cent (Jaffe, 1989; Jaffe and Trajtenberg, 2002) (quoted in RCUK).
- A 1% increase in public basic pharmaceutical research leads to a 1.7% increase in industry R&D after eight years. And a 1% increase in public clinical research leads to a 0.4% increase in industry R&D after three years (Toole, 2007) (quoted in CaSE, 2010).
- This additional research expenditure does not just translate into higher researcher wages; it generates additional research (Aerts, 2008; Lokhsin and Mohnen, 2008).

The crowding-in or leverage effect of public subsidies for private research is larger in the case of more productive collaborative research

- The crowding-in/leverage effect of public funding is larger for industry-science collaborative research than for pure industrial research (Czarnitzki, 2011).
- Industry-science collaborative research projects produce larger spill-over effects than pure industrial research projects (Czarnitzki, 2011).

Public subsidies for private research increase the total amount of innovation (output additionality)

- Subsidized private R&D leads to more innovation output. It has a positive impact on patents and new product sales (Czarnitzki, 2011).

THE ADDED VALUE OF EU-LEVEL SUPPORT FOR RESEARCH AND INNOVATION IS UNDISPUTED

All FP ex-post evaluations agree that EU level support in the field of research and innovation is marked by European added value. Thanks to EU initiatives in fields like frontier research (ERC), research infrastructures (ESFRI), the coordination of research funding (JTIs, joint programming), and research training and career development (Marie Curie Actions), the European R&D landscape is radically changing for the better. In addition, the EU supports actions like cross-border collaborative research, cross-border research mobility and cross-border access to research infrastructures that are most efficiently organised at EU level, that are of strategic importance, and for which no alternatives exist

The literature is unanimous

The European added value of EU intervention in the field of research and innovation is undisputed:

- The FP7 interim evaluation (Annerberg et al., 2010) concluded that "FP7 is assessed to fill in important gaps between national research activities, thus gaining critical mass in many areas and ensuring added value, as the assessments suggest that the FP7 activities are not likely to have been implemented without EU level funding".
- The FP6 ex-post evaluation (Rietschel et al., 2009) concluded that "the activities under FP6 … generated European added value" and that "FP6 was a powerful mechanism for catalysing RTD in Europe that could only be realised through action at the European level", and "[could] find no evidence that plausible alternative approaches would have been more successful in the same timeframe, acknowledging the ambition, scale and importance of FP6".
- The Five-Year Assessment 1999-2003 (European Commission, 2005) concluded that all evidence seen by it "whether at Community or Member State level, consistently emphasised the significant additionality and European added value for the Framework Programmes".

- European S&T expert Erik Arnold (2009) states the widely held consensus view that "[FP] projects were mostly 'additional' in the sense that they would not have been conducted without European funding", that "their role was therefore quite distinct from nationally funded projects", and that "FP6 provided opportunities for extended international and cross-sectoral networking, for projects of a greater scale (particularly financial scale), and for projects of a greater technical and scientific complexity – opportunities which would have been severely limited without the funds it made available".

Thanks to EU initiatives, the European R&D landscape is radically changing for the better

- **The EU created the European Research Council, which promotes excellence across Europe:**
  - The European Research Council would not have been created without an EU initiative. The EU would then have been left with a landscape of compartmentalized national research councils, but would have had no funding mechanism to promote EU-wide competition for funds and to encourage higher scientific quality in frontier research.
- **The EU leads in the creation and use of research infrastructures of pan-European importance:**
  - Thanks to EU leadership, for the first time, a pan-European strategy on research infrastructures (the so-called ESFRI roadmap) has been developed and is now being implemented. No less than 10 next generation European infrastructures [e.g. IAGOS (In-service Aircraft for a Global Observing System), ESS (European Spallation Source) and SHARE (Survey of Health, Ageing and Retirement in Europe)] are currently being built by groups of Member States and these facilities would not have seen the light of day if it were not for EU action. In addition, without EU funding measures to facilitate access to unique and expensive infrastructures, 9 out of 10 researchers say that they would not have been able to access vital research facilities, which is a often a precondition for successful frontier research. For example:
    - The IA-SFS project has created the largest network of free electron lasers and synchrotrons in the world, serving several thousand European scientists and allowing a wide range of applications.
    - The European Grid Infrastructure gives European researchers access to the aggregated processing power of 200 000 computers in the world's largest distributed computing infrastructure ever built, with over 290 sites in more than 50 countries, utilised by 13 000 researchers.
- **The EU makes it easier for private companies to develop and implement joint strategic research agendas, which help to boost their competitiveness and stimulate smart, sustainable and inclusive growth:**
  - An important achievement of the Framework Programme has been to establish instruments and mechanisms (e.g. European Technology Platforms, Joint Technology Initiatives) that facilitate the joint development and implementation of strategic research agendas by the private sector and for public-private partnership. These strategic research agendas have played a key role in boosting the competitiveness of the sectors involved. For example:
    - The Innovative Medicines Initiative is helping to make Europe the most attractive place for pharmaceutical R&D, thereby enhancing access to innovative medicines for patients. It does so by providing new tools and methodologies to remove major bottlenecks in drug development.
    - The Clean Sky joint technology initiative is bringing significant step changes regarding the environmental impact of aviation. Clean Sky will speed up technological breakthroughs and shorten the time to market for new and cleaner solutions tested on full scale demonstrators. It will thus contribute significantly to reducing the environmental footprint of aviation (i.e. emissions and noise reduction but also green life cycle) for future generations.
- **The EU helps bring together compartmentalized national research funding across borders so as to achieve the scale needed to tackle important societal challenges:**
  - One of the pioneering achievements of the Framework Programme has been to establish instruments and mechanisms (e.g. ERA-NET, Article 185) for the joint programming of Member State research. This has led to a new approach to research funding involving countries pooling and coordinating their own national funds across borders. For example:

    - A pilot Joint Programming action has brought together 23 Member States and associated countries to jointly develop and fund a strategic research agenda for tackling neurodegenerative diseases and Alzheimer's.
    - EURAMET is an action aimed at coordinating metrology research across Europe. Involving 22 National Metrology Institutes it pools 44% of overall metrology resources in one initiative, reducing duplication of research and encouraging the more efficient use of resources.

The EU most efficiently organises cross-border research and mobility actions that are of systemic and strategic importance and for which no alternatives exist

- **EU cross-border research, innovation and mobility actions are of systemic importance:**
  - **Cross-border collaborative research and innovation collaboration actions** are of key importance since they underpin the 'open innovation' paradigm:
    - It enables the achievement of the **critical mass** required for breakthroughs when research activities are of such a scale and complexity that no single Member State can provide the necessary financial or personnel resources, so when, for instance, a large research capacity is needed and resources must be pooled to be effective or when there is a strong requirement for complementary or comparative knowledge and skills (e.g. in highly inter-disciplinary fields). Telling examples are rare diseases research, space research, ICT, etc. For example, when researching rare diseases the FP helps to bring together the necessary critical mass of patients, expertise, and facilities. There are at least 6000 to 7000 rare diseases, which taken together affect some 20 million European citizens. However, research at national level is often hampered by a thin distribution of patients, few specialised research groups, and a lack of standardisation of available data and material collections.
    - It enables research addressing **pan-European policy challenges**. Public policy challenges have become increasingly international (e.g. environment, health, food safety, climate change, security) and their resolution has become increasingly dependent upon the establishment of a common scientific base. Moreover, research can lead to the establishment of harmonized laws and standards. Given the shared interest and the scale on which these issues arise, such research activities are best organised in a cross-border collaborative manner.
    - It reduces risk and enables the achievement of **pan-European standards**. Working in trans-national consortia helps firms to lower research risks, thus enabling certain research to take place. Involving key EU industry players helps reduce commercial risks, by ensuring that research results and solutions are applicable across Europe and beyond, enabling the development of EU- and world-wide standards and interoperable solutions, and offering the potential for exploitation in a market of 500 million people. The FP supports the kind of pan-European research collaboration required to speedily produce industrial standards that can set the tone and be adopted at the global level. ICT research & innovation, for instance, is increasingly organised around new kinds of collaboration involving common, open technology platforms with high spill-over and leverage effects. They allow a much wider range of stakeholders to profit from new developments and further innovate. Federating and partnering at EU level helps ensure that research results and solutions are applicable across Europe and beyond. It enables consensus building, interoperable solutions and the development of EU- and world-wide standards. EU research also provides an important umbrella to facilitate globally interoperable ICT systems, global consensus and standards. Direct EU level actions also support pre-normative research in support of standardisation, harmonization and development of reference materials and methods. Without the FP, Europe would not have been at the origin of the global standard for 2G and 3G mobile communications.
    - It enables the rapid and wide **dissemination** of research results – to users, industries, firms (SMEs in particular), citizens, etc. – leading to a better exploitation of research, and giving a larger impact than would be possible only at Member State level.
    - **Growing innovative SMEs**: Innovative SMEs, for instance in the field of ICT and services, play a vital role in generating new ideas and transforming these into business assets. They are agile, able to focus their research and innovation efforts and take fast technical and business decisions. SME involvement in research and innovation at EU level improves their partnerships and alliances with other companies and research labs across Europe. It enables innovative SMEs to develop new

products and services beyond their in-house and national capabilities. And, it allows them to grow and enter new international markets.

  - **Leveraging private investment**: Through EU research schemes such as collaborative research, Joint Technology Initiatives (ARTEMIS, Clean Sky, ENIAC, FCH, IMI), and Joint Programming initiatives (e.g. EDCTP, AAL, Eurostars, EMRP), private companies can collaborate with foreign partners at a scale not possible at national level, in projects tested for excellence and potential market impact, which induces them to invest more of their own funds than they would under national funding schemes. In the field of key enabling technologies (KETs), for instance, a common European strategy with coordination mechanisms creates synergies and economies of scale that lead to improved industrial exploitation of KETs in the EU.

- o **Marie Curie cross-border and cross-sector researcher mobility and training actions** are of key importance as they can increase the quantity and quality of the EU's research knowledge base by attracting young people into research, attracting top researchers to come to Europe and ensuring excellent training to the coming generations of European researchers; have a pronounced structuring effect on the European Research Area by setting standards for innovative research training, promoting attractive career development for researchers from all nationalities at all levels of their career, setting standards of attractive employment conditions and open recruitments for all EU-researchers, spreading good practices of the European Researchers Charter and Code of Conduct for the Recruitment of Researchers, and leveraging additional financing and aligning national resources through the co-funding mechanism of fellowship programmes; strengthen innovation by exposing researchers to an industrial environment at an early stage of their career, promoting long-term cooperation between academia and industry, and ensuring participation of a broad spectrum of small and large enterprises in the training and career development of researchers.

- o **Cross-border innovation support actions** – comprising innovation 'policy intelligence' (gathering and processing analytical data for better policy making in innovation cannot be achieved without the EU dimension and the cross-country comparisons) and innovation 'policy learning' (important added-value comes from bringing together knowledge and experience from different contexts, supporting cross-country comparisons of innovation policy tools and experiences and the opportunity to identify, promote and test best practice from over the widest possible area) - contributes to better policies and tools for supporting businesses in bringing innovation to the market. The ICT PSP component of CIP has been able to bring Member States together to test deployment of innovative ICT applications at real scale. These actions aim at stimulating demand and facilitating formation of markets in areas with high untapped potential such as cross-border e-health services. Cross-border innovation support actions also comprise EU level venture capital support. High-tech start-ups require venture capital. Venture capital markets can only function well at European scale, however, and improvement requires European action. It is only possible at European level to achieve the necessary scale and the strong participation of private investors that are the hallmarks of a self-sustaining venture capital market. Many successful companies such as Skype, WaveLight AG, Fimasys, etc. would not exist today without the funding and guidance provided during their early stages by venture capitalists supported by the CIP-EIP. Specialised innovation support, access to venture capital or benchmarking innovation management performance against competitors would be best provided through an 'internal market for innovation support'.

- **EU cross-border research, innovation and mobility actions are of strategic importance to participants:**

  - o A study on ICT under FP4 and FP5 (Databank Consulting et al., 2004) found that FP collaborative research funded mainly two types of R&D projects: (1) "Core" projects: highly interesting, necessary and strategically important projects that occur in the core technology areas of the respondents (58 percent of projects); (2) "Complex-risky" projects: long-term, technically complex, and risky from commercial and technical point of view (26 percent of projects)40 % of industry participants in FP6-IST reported their research in the ICT programmes being of high to very high commercial risk.

  - o A study on Marie Curie actions under FP4 and FP5 (Van de Sande et al., 2005) found that participating in such actions was perceived as having an important impact (score of up to 90 percent) on issues central to career development like the development of research skills, the accumulation of international experience, the development of transnational research networks, etc.

- An Austrian study on FP4 (Joanneum Research et al., 2001) found that most FP projects were seen as of strategic importance: 37.7% of EU projects were seen as of central importance and 53.7% of EU projects supported other innovation activities. FP projects were closer to the scientific-technological core concentration of the company, more involved, and more application-oriented than nationally funded projects and against this backdrop, FP projects gained a specific strategic significance for companies.
- A Danish study on FP4 (Danish Institute for Studies in Research and Research Policy, 2000) found that more than 90% of participants participated in projects with a research content close to the core of the workplace. Close to 75% of participants indicated that the projects were part of the long-term strategic R&D.
- A Finnish study on FP4 (Luukkonen and Hälikkä, 2000) found that most FP projects were either of strategic/central importance or of potential future importance/supporting other research activities. For big companies, for instance, the shares were over 20 percent and over 55 percent respectively, while for SMEs, the shares were 40 percent and over 40 percent respectively.
- An Irish study on FP4 (Forfas, 2001) found that, generally speaking, the projects undertaken by Irish participants were complex, exciting, long-term projects in core technologies which most organisations considered of strategic importance and high relevance to their organisations.
- A survey covering the whole of FP5 (ATLANTIS Research Organisation et al., 2004) found that most FP5 projects were seen as strategically important projects in core technology areas for the organisations concerned. Typically they were tightly linked either conceptually or more pragmatically with other in-house projects but were only feasible when undertaken in collaboration with others. Projects were generally of a high scientific and technical complexity and skewed towards the longer-term end of the spectrum. Work of an applied R&D nature nevertheless still predominated over more basic research, especially for industrial participants.
- A Finnish study on FP5 (Uotila et al., 2004) found that FP-funded projects were either of high current or of future strategic importance. For big companies, for instance, the shares exceed 20 percent and 55 percent respectively, while for SMEs, the shares exceeded 20 percent and 65 percent respectively.
- A Norwegian study on FP5 (NIFU, STEP and Technopolis, 2004) found that EU-funding seemed to stimulate businesses to get involved in more risky research than otherwise, which could widen their technological horizons and opportunities.
- The Innovation Impact study on FP5 and FP6 (Polt et al., 2008) found that, compared to collaborative research projects funded exclusively via internal R&D budgets, FP projects were, on average, characterised by lower commercial risk, longer term R&D horizon, more interest in 'peripheral' technologies outside the core technologies of participants, and a focus on exploration (rather than exploitation) strategies.
- A survey covering the whole of FP6 (IDEA Consult, 2009) found that "FP funded projects are incomparable with national/regional funded projects, as their objectives and characteristics are very different" (p24) and that "the average research project funded under FP6 [concerns] long-term, strategically highly important, technically highly complex R&D in a core technological area of the organisation. … It is tightly linked with other in-house projects but mainly considered only feasible with external collaborators" (p20).
- A German study on FP6 (Federal Ministry of Education and Research, 2009) found that large, export-oriented companies as well as companies in the field of cutting-edge technology and the knowledge-intensive service sector were more likely to take part in FP6 than in federal or Länder programmes. They concluded that the European and international focus of the FPs was particularly attractive for companies in sunrise sectors.

- **Without the EU programmes, most of these strategically important research and innovation actions would simply not take place or be far less ambitious**
  - Interview-based evidence indicates that in the absence of CIP funding, eco-innovation projects would not have benefited from cross-border cooperation and learning and the resulting EU-wide market scope. Most beneficiaries indicated that they would not have moved forward with the development of the

technology or, had they done so, it would have been at a much smaller scale focusing on the needs and characteristics of the national or regional markets.

- As Table 1 below shows, the FP achieves very high levels of overall "project additionality": without FP funding, the great majority of FP projects would not have been carried out at all (hypothetical case). This is a first key finding that is highly robust: it is a finding valid across a series of FPs and across a range of different actions; it is a finding resulting from Commission-commissioned evaluation studies as well as nationally commissioned evaluation studies; and it is a finding confirmed through control groups: the great majority of rejected FP proposals never got implemented (experimental case).
- A second key finding is that the levels of overall "project additionality" achieved by the FP are much higher than those achieved by most European and non-European national R&D funding schemes (Compare Tables 1 and 2). It seems that there are far fewer substitutes for EU funding than there are for national schemes.
- A third key finding is that the FP achieves very high levels of "behavioural additionality": the great majority of those projects that would have been carried out in the absence of EU funding would have changed dramatically, undermining their strategic importance: they would have been carried out on a smaller scale (with less money, with fewer partners), with a reduced scope (less ambitious), and at a later stage or over a longer period of time.
- A fourth key finding is that the levels of "behavioural additionality" achieved by the FP are much higher than those achieved by most European and non-European national R&D schemes.
- A fifth key finding is that the FP achieves very high levels of "project" and "behavioural" additionality not only overall but also and particularly for strategic projects. This is once more a finding that is highly robust: it is a finding valid across a series of FPs; it is a finding resulting from Commission-commissioned evaluation studies as well as nationally commissioned evaluation studies; and it is a finding confirmed through control groups:
  - A study on ICT under FP4 and FP5 found high levels of project additionality for the FP overall (Table 1) as well as for strategically important projects (below) (Databank Consulting et al., 2004).

		Additionality	
		Project possible only with EU funding	Project potentially able to find other funding
All projects	High strategic imp	55%	19%
	Low strategic imp	18%	7%
Core projects	High strategic imp	61%	22%
	Low strategic imp	9%	1%
Complex-risky projects	High strategic imp	45%	12%
	Low strategic imp	20%	10%

  - A Finnish study on FP4 (Luukkonen, T. and S. Hälikkä, 2000), found high levels of additionality for the FP overall (Table 1) as well as for strategic projects (below).

			Additionality		
			High	Low	None
Firms	Strategic value	Of central importance	42	53	5
		Of potential future importance	49	49	2
		Of marginal importance	49	49	2
Non-firms	Strategic value	Of central importance	45	49	6
		Of potential future importance	58	39	3
		Of marginal importance	67	30	3

- A survey covering the whole of FP5 (ATLANTIS Research Organisation et al., 2004) found high levels of additionality for the FP overall (Table 1) as well as for strategic projects (below).

			High	Low	None
	Pure Additionality	Behavioural Additionality	No Additionality	Negative Additionality	Total
High Strategic Importance	38.7%	30.6%	3.8%	0.9%	74.0%
Moderate Strategic Importance	13.6%	4.6%	1.1%	0.1%	19.4%
Low Strategic Importance	4.9%	1.3%	0.3%	0.1%	6.6%
Total	57.2%	36.5%	5.2%	1.1%	100.0%

- A survey covering the whole of FP6 (IDEA Consult, 2009) found high levels of additionality for the FP overall (Table 1) as well as for strategic projects (below).

	Low to very low strategic importance	Medium strategic importance	High to very high strategic importance	Weighted average
	FP5 additionality and strategic importance			
No additionality	14%	5%	5.5%	6%
Behavioural add.	14%	25%	42.5%	37%
Pure additionality	72%	70%	52%	57%
Total	7%	20%	73%	100%
	FP6 additionality and strategic importance (experimental group)			
No additionality	0%	4%	5%	4%
Behavioural add.	27%	37%	42%	39%
Pure additionality	73%	59%	53%	57%
Total	11%	27%	62%	100%
	FP6 additionality and strategic importance (control group)			
No additionality	7%	4%	7%	6%
Behavioural add.	21%	29%	38%	33%
Pure additionality	72%	68%	55%	61%
Total	14%	28%	58%	100%

- According to a survey among participants in FP5/FP6 ICT projects (WING, 2009), the evolution from FP5 to FP6 saw larger enterprises and SMEs shifting their focus towards longer-term research of high strategic importance in what they considered their core R&D area. This trend continued into FP7 and saw further increases in the strategic importance of FP7 ICT research for all stakeholder groups, whereby 70% of all surveyed participants deemed the programme of high to very high strategic importance for their own organisation (Technopolis, 2010c).

Table 1: Evaluations of the FP

FP	Study owner – Scope of the Evaluation	Full Project Additionality (Share of respondents who did (failed applicants) or would (participants) abandon the project in the absence of FP funding	Partial Project Additionality (Share of respondents who did (failed applicants) or would (participants) change the nature of the project in the absence of EU funding) (*: share of total respondents; **: share of respondents who did (failed applicants) or would (participants) not abandon the project)				Reference
			Scale additionality (Share of respondents who did (failed applicants) or would (participants) reduce the scale of the project in the absence of FP funding)	Acceleration additionality (Share of respondents who did (failed applicants) or would (participants) postpone or increase the duration of the project in the absence of FP funding)	Scope additionality (Share of respondents who did (failed applicants) or would (participants) reduce the scope or objectives of the project in the absence of FP funding)	Networking Additionality (Share of respondents who did (failed applicants) or would (participants) reduce the number of (international) partners in the absence of FP funding)	
FP3&4	EC – BriteEuram	• 45% large companies would • 51% SMEs would	• 44% large companies would* • 22% SMEs would*		90% would*		European Commission (2002)
FP4&5	EC – IST	• 73% would					Databank Consulting et al. (2004)
FP4&5	EC – Marie Curie	• 69% would (Cat 20)[1] • 53% would (Cat 30) • 70% would (Cat 40)					Van de Sande et al. (2005)
FP4	National – Austria	70.1% would	86% would**				Joanneum Research et al. (2001)
			40% would**		52% would**	40% would**	
FP4	National – Denmark	70% would	60% would*	50% would*			Danish Institute for Studies in Research and Research Policy

[1] Sum of answers "important" and "very important, I would not have gone abroad otherwise" for question on importance of Marie Curie for stimulating mobility.

							(2000)
FP4	National – Finland	54% would	22% would*	19% would*	17% would*		Luukkonen and Hälikkä (2000)
FP4	National – Ireland	82% would	>70% would**	Almost 40% would**	Almost 80% would**	Almost 40% would**	Forfas (2001)
FP4&5	National – UK	70% would	17% would*				DTI - Office of Science and Technology (2004)
				59% would**	90% would**	64% would**	
FP5	EC – All	• 57% would • 84% did	• 36%would* • 16% did*				ATLANTIS Research Organisation et al. (2004)
			• 76% would** • >40% did**	• 33% would** • >50% did**	• 43% would** • 6% did**	• 70% would** • 43% did**	
FP5	EC – Growth	69.6% would				20.9% would*	Matrix Insight Ltd. (2008)
FP5&6	EC – SME	55% would		45% would*	45% would*		European Commission (2007)
FP5	EC – Research Infrastructure Access	88% would					European Commission (2003)
FP5	National – Finland	70% would	40% would*	36% would*	14% would*		Uotila et al. (2004)
FP5	National – Norway	Almost 95% would	>90% would*	>80% would*	47% would**	<80% would**	NIFU, STEP and Technopolis (2004)
FP5&6	National – Switzerland	• 75% would • 70% did					Interface Institut für Politikstudien and Fraunhofer-Institut für System- und Innovationsforschung (ISI) (2005)
FP6	EC – All	• 66% did • 57% would	29% did* 38% would*				IDEA Consult (2009)
			76% did** 83% would**	60%/57% (start/duration) did** 44%/46% (start/duration) would**	71% did** 78% would**	69% did** 80% would**	
FP6	EC -All	• 59% did (control group I) • 63% did (control group II) • 57% would	• 35% did (control group I)* • 33% did (control group II)* • 39% would*				IDEA Consult (2009)
FP6	National – Finland	80% would	53% would*	39% would*	40% would*		TEKES (2008)
FP6	National – Ireland	56% did					Forfas (2009)
FP6	National – Spain	74% would	23% would*				Zabala Innovation Consulting SA (2010)

Table 2: Evaluations of national R&D support schemes

Study owner – Scope of the Evaluation	**Full** Project Additionality (Share of respondents who did (failed applicants) or would (participants) abandon the project in the absence of national funding	**Partial** Project Additionality (Share of respondents who did (failed applicants) or would (participants) change the nature of the project in the absence of EU funding) (*: share of total respondents; **: share of respondents who did (failed applicants) or would (participants) not abandon the project)				Reference
		Scale additionality (Share of respondents who did (failed applicants) or would (participants) reduce the scale of the project in the absence of national funding)	**Acceleration** additionality (Share of respondents who did (failed applicants) or would (participants) postpone or increase the duration of the project in the absence of national funding)	**Scope** additionality (Share of respondents who did (failed applicants) or would (participants) reduce the scope or objectives of the project in the absence of national funding)	**Networking** Additionality (Share of respondents who did (failed applicants) or would (participants) reduce the number of (international) partners in the absence of national funding)	
Austria - FFF	• 28% would • 31% did	• 57% would* • 47% did*				Falk (2004); Joanneum Research, WIFO and KOF (2004); OECD (2006)
		• 74% would** • 60% did**	Postpone: • 32% would** • 43% did** Lengthen: • 51% would** • 61% did**	• 49% would** • 40% did**		
Flanders - IWT	29% would	46% would*				Georghiou et al. (2004); OECD (2006)
Flanders - IWT	• 41% would • 43% did	• 48% would* • 25% did*				Steurs et al. (2006)
Australia – R&D Start Programme	37% would	90% would**	100% would**		59% would**	OECD (2006)
Finland – TEKES funding	20% would	46% would*		>60% pursued R&D not connected to the short-term needs of business operations >70% realised riskier and more profitable research		OECD (2006)
Norway – Innovation Norway funding	53% would	16% would have reduced scale or postponed*				OECD (2006)

US - ATP	93% would			82% of projects more ambitious than other R&D projects 70% of projects more technically difficult than other R&D projects		OECD (2006)