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IN THE SIXTH FRAMEWORK PROGRAMME

Evaluation of pertinence and impact
Synthesis report

STUDY

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EUROPEAN COMMISSION

Community Support for Research Infrastructures

in the Sixth Framework Programme

Evaluation of pertinence and impact

Synthesis report

Evaluation study for the European Commission
by the Rambøll Management-Matrix-Eureval Consortium

2009 Directorate-General for Research EUR 24051

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Foreword

Large-scale Research Infrastructures are essential for reinforcing the competitiveness of Europe's science base, since they do not only allow for the development of new knowledge, but are also essential for training the next generation of top researchers and technology transfer towards industry. As the construction of the next generation of large-scale facilities is increasingly complex and costly, EU Member States together with the European Commission have agreed on the development of a European strategy. The concrete translation of this is the famous ESFRI Roadmap which contains some 44 large-scale Research Infrastructures which Europe's scientific community needs in order to be able to carry out top-level research over the next 5–15 years. The facilities of the ESFRI Roadmap are both single-sited (e.g. research vessels, telescopes) and distributed (e.g. databases, biobanks) and cover various disciplines from humanities to physics and from life sciences to materials. Several projects of the ESFRI Roadmap are currently moving towards implementation and the European Commission is supporting the preparation phase of their construction under the Seventh Framework Programme.

Besides investing in the next generation of Research Infrastructures, it is essential that Europe uses the existing facilities in the best possible way. This means optimising access to these facilities and creating networks of infrastructures to allow for integrating activities and joint research projects. In the last 20 years the European Commission has supported the operation of and cooperation between existing facilities through different Framework Programmes. Over the years some 500 research infrastructures have participated in EU projects facilitating the work of thousands of researchers.

A study was commissioned by the European Commission to assess the impact of the EU activities under the Sixth Framework Programme as regards existing Research Infrastructures. The aim of this study was threefold: (1) to assess the added value of Community actions for integrating and developing Research Infrastructures; (2) to reflect on the socio-economic impact of the Community actions; and (3) to identify gaps, needs and ideas for possible future actions with the aim of strengthening the European Research Area.

I am confident that, on basis of this study, further analysis, to be carried out in the future, will help us to improve methodologies and indicators to measure the socio-economic impact of Community actions in the field of Research Infrastructures.

Robert-Jan Smits

Director
European Research Area:
research programmes and capacity
DG Research, European Commission

September 2009

Evaluation for the European Commission

This impact assessment and ex post evaluation was commissioned by the European Commission's Directorate-Generals for Research and Information Society and Media (Framework contract: BUDG 06/PO/01/Lot 3).

The impact study was carried out by a mixed team of experts from Matrix Insight Ltd in association with Rambøll Management and PREST/ Manchester Institute of Innovation Research at Manchester Business School. The team was led by Mrs Mariell Juhlin from Matrix Insight (mariell.juhlin@matrixknowledge.com). The research team consisted of Silja Korpelainen, Kristin Höltge, Benedicte Akre, Pawel Janowski, Kevin Marsh, Evelina Bertranou, Janne Sylvest, Xavier le Den, Jacques Viseur, Katleen Vos, Chris Fox and Kate Barker.

The evaluation was managed by Commission staff from DG Research, Unit Research Infrastructures. Its progress was monitored by a steering group composed of Commission staff from DG Research and DG Information Society and Media.

The opinions expressed in this document represent the authors' points of view which are not necessarily shared by the European Commission.

The more detailed information about methodologies and the broad study findings, including impact and economic analysis, are preserved in the *Technical Appendices* available at: http://ec.europa.eu/research/infrastructures.

ACRONYMS

CA: Coordination Action
CERN: European Organization for Nuclear Research
CND: Communication Network Development (e-infrastructures)
CNI: Construction of New Infrastructures
DG INFSO: Directorate-General for Information Society and Media
DG RTD: Directorate-General for Research
DS: Design Study
EAV: European Added Value
EC: European Commission
ERA: European Research Area
ESF: European Science Foundation
ESFRI: European Strategy Forum on Research Infrastructures
FP: Community Framework Programme for Research
I3: Integrated Infrastructure Initiative
IA: Integrating Activity
ICT: Information and communication technology
IPR: Intellectual Property Right
NRENs: National research and education networks
NMS: New Member States
RI: Research Infrastructure
SSA: Specific Support Action
S&T: Science and Technology

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Executive Summary

INTRODUCTION

Scope

In July 2007, the Directorates-General for Research (DG RTD) and for Information Society and Media (DG INFSO) commissioned a 22-month study to assess the impact of EC support to Research Infrastructures (RIs) under the Sixth Community Framework Programme for Research (FP6) (2002–2006). The study, which was carried out by Matrix Knowledge Group in cooperation with Rambøll Management and PREST, covered all modes of EU support actions to RIs under FP6 (i.e. Specific Support Actions – SSA, Integrated Infrastructure Initiatives – I3, and Coordination Actions – CA), except only for Transnational Access contracts.

The study covered 83 RI projects with an average of 18 participants per project over nine research domains in over 50 countries. 70 of these projects were related to DG RTD and 13 to DG INFSO.

Objectives of the evaluation and methods used

The aim of the evaluation was to gather a wide range of evidence of the impact of EU support actions on RIs in Europe. The overall objectives of the evaluation were to:

- assess the pertinence of the EU support schemes and the added value of European action
- gain an overview of the impact that the EU support actions have had on scientific communities, RIs, research policy, the economy, industry and wider society
- analyse the structuring effect of support actions with regards to the European Research Area (ERA) and provide the Commission with recommendations for further Community actions regarding RIs.

To effectively address these objectives, the study adopted a before-after evaluative framework for the systematic assessment of impact and pertinence. A mix of methods for the collection and analysis of evidence were used. The study involved a Delphi survey; Rapid Evidence Assessment of existing literature; an online survey of project coordinators and participants; a detailed review of project descriptions of work; interviews with stakeholders; and 30 structured case studies involving 176 interviews. Statistical analysis from the case study sample and project survey data allowed conclusions to be drawn about the impacts of the programme as a whole.

EU support actions under FP6

The overall objective of the EU support to RIs under FP6 was to promote the development of RIs of the highest quality and performance in Europe and their optimum use on a European scale based on the needs expressed by the community. RIs were seen as an essential element for research in Europe to remain at the leading edge. The support aimed to:

(i) enhance existing infrastructures
(ii) ensure access to the infrastructures irrespective of their location
(iii) provide support for the development of new RIs.

The RI support actions also sought to respond to the wider objectives of FP6 – to contribute to the creation of the ERA by improving integration and coordination of research in Europe; strengthening the competitiveness of the European economy through research; helping to solve major societal questions; and supporting the formulation and implementation of EU policies. Within FP6, the new instrument of the Integrated Infrastructure Initiative (I3) sought to promote the networking and research cooperation of similar infrastructures, while design studies and construction of new infrastructure projects prepared for the future. The RI support actions have been running alongside extensive activities in discussing the future of European RIs through the independent European Strategy Forum on Research Infrastructures (ESFRI), which has identified the scientific need for future RIs in its 'roadmap'. The e-infrastructure (Communication Network Development) element of the programme aimed to enhance the communications network for European researchers (GEANT) and to foster and enhance the deployment of grid infrastructures, to promote further breadth and depth of collaboration of researchers in Europe and beyond. The projects were selected through open calls by peer review for excellence and relevance.

KEY FINDINGS

Pertinence of the Research Infrastructures programme

Pertinence in relation to the needs of the research community

There is clear evidence from the study that the programme has met its objectives in relation to the needs of the research community. 90% of the projects included the most relevant partners according to the project coordinators. The EC funding provided was also viewed as appropriate in meeting project goals for just over 60% of the projects and appropriate for meeting the needs of the scientific communities in a little over 50% of the projects.[1] However, the 'bottom-up' nature of the projects means that some of the wider aspirations for the programme in relation to making a broader economic and social impact have not been realised. Programme effects, particularly pertaining to European added value, do not appear to be sustainable, with most projects relying on further EC funding to continue with European-level networking and cooperation. Overall, a majority of projects fully met their objectives and included the most relevant participants. Most projects underwent some form of external assessment during implementation which resulted in just minor changes to their running. Only a minority of projects would have been able to carry out the same activities – either in a different way or in a reduced capacity – in the absence of Commission funding. Generally, projects were satisfied with the contract conditions, although they pointed to possible improvements.

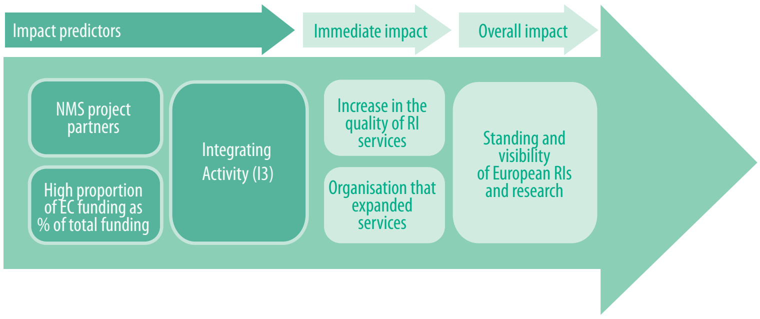
Impact of the Research Infrastructures programme

Impact on Research Infrastructures

There was strong evidence of the impact on the improved standing of European RIs and on European research. As a result of FP6 funding, a majority of projects (66.2%) were able to provide better-quality RI services. This in turn led to improvements in the resulting quality of research data. Just over half of the projects were also able to increase the number of young researchers working in the relevant area as well as to expand the range and types of service offered to users. In addition, EC funding of I3s directed to Integrating Activity (IA) projects produced a greater effect on the number of young researchers working in partner institutions in the area of the project than funding directed to e-infrastructure (Communication Network Development) projects.

In relation to the achievement of impacts on the RIs themselves, I3 projects and the presence of New Member State (NMS) partners in the project consortia contributed to the increase in the quality of RI services and that of the resulting research data. The presence of NMS also positively helped increase the number of young researchers working in the relevant research area. Moreover, a high proportion of EC funding, in relation to the total project budget, was associated with an increase in the remote use of the RI and expansion of services offered.

Figure 1: Overview of key impacts and predictors of impact



Diverse and marked impact on science communities

A large majority of projects (80%) increased the degree to which researchers were networked in the relevant area of science. Evidence showed that the support actions had led to national RIs opening up to European and other international scientific users. For half of the projects, the number of scientists that received training in the use of equipment rose and just under half of the projects generated more integrated datasets due to the support. Relatively few projects, however, had opened up their RI facilities to new scientific user communities that had not previously used the RI facilities, although there was clear evidence of RIs opening to European and international scientific users. In addition, only very limited, anecdotal evidence was found of projects being able to attract or retain scientists in Europe. In fact, if anything, a noticeable trend of project researchers moving to industry was found.

With reference to impacts on science communities, I3 projects were found to lead to an increase in the number of people receiving training in the use of equipment, while also contributing to a rise in access to the RI due to IT quality. In addition, e-infrastructure projects were associated with a greater growth in the number of non-European users than for the overall group of projects examined. Furthermore, EC funding of I3s directed to Integrating Activity projects produced a greater effect on the number of people receiving training in the use of equipment than funding directed to e-infrastructure projects.

Impact on research policy is clear at regional, national, European and international levels

There was evidence to suggest that projects influenced R&D policies at regional, national, European and international levels. Those that were close to completion were positively associated with a rise in priority given to their domain and/or RI in national research policies. Compared

1 Please note that the above percentages relate to information from 54 projects (65% of all the projects) and are assessments made by the project coordinators.

with other projects, e-infrastructure projects were particularly likely to increase the priority given to their domain and/or RI in national research policies. Overall, the effect on policy-making in domains beyond that of immediate focus for the projects was small.

Impact on economy/industry is apparent in isolated cases

Little concrete evidence of impact on economy and industry was found except in isolated cases. A moderate effect was found in relation to RIs generating new business for suppliers or manufacturers of goods and services, as well as in projects triggering researchers to move into industry. For a small minority of projects, industry use of the RI increased as a result of the European support and joint projects with industry took place. Very few projects had a commercialisation strategy or licensing agreements in place. There was hardly any evidence of projects having realised intellectual property rights (IPRs)/patents, created spin-off companies, generated new industrial processes or regional economic impact. However, EC funding directed to Specific Support and CA projects were found to have produced a greater effect on industry participation than funding directed to I3 projects.

Impact on wider society was not measurable

There was evidence of impact toward long-term realisation of societal impacts. A large majority of projects had public dissemination strategies in place and a majority also encouraged the non-commercial use of research resources (although it is likely here that the projects were referring to use by other scientists). A minority of projects had realised some form of liaison with local communities. Only a few projects had created actual wider societal impacts. In instances where they had, these covered increased awareness and knowledge of research among lay audiences and specific advances in fields such as medicine, environment and safety.

With reference to achieving impact on wider society, projects that were close to being completed were positively associated with liaison with local communities. This provides an indication of societal dissemination that in the longer term may lead to greater societal impacts.

European added value resulting from the Research Infrastructures programme

European added value (EAV) is evident from the European support actions

There is clear evidence that European support actions have added value. While few projects clearly stated that they would not have been possible at all without EC financing, the large majority were of the view that the European funding enabled certain activities that would not have been possible otherwise. From the perspective of the RIs, EAV was related to leading to better coordinated R&D activities and harmonisation in operations, such as coordinated access application across the network. Moreover, the fact that Commission funding increased the RIs' visibility helped to establish research fields at European level.

In relation to the achievement of impacts, a high proportion of EC funding in relation to the total project budget was positively associated with achieving impacts, in particular, rises in networking of researchers, increased remote use of the RI, more number of people receiving equipment training, and the expansion of services. EC funding directed to SSA and CA projects produced greater effect on industry participation.

Structuring effect of the Research Infrastructures programme

The European Research Area (ERA) is strengthened

There was clear evidence that EU support actions had contributed to the structuring of the ERA. In relation to a large majority of projects, the degree to which researchers participated in networking had risen. In addition, the findings indicate that researchers from New Member States were more involved in European communities and networks than before as a result of the support. Further, the European funding has enabled scientists, particularly those in the NMS, to undertake new, more or better research. This in turn has led to improvements in research in these countries. There was also evidence that the inclusion of NMS partners into European RI projects triggered national investment in RIs as their visibility and prestige grew.

Regarding structuring of the ERA, a high proportion of EC funding in relation to the overall project budget was associated with an increase in the number of researchers who networked.

Key Recommendations

The study made several recommendations for future Community actions in the area of RIs. The key recommendations related to the following areas:

- **Improving efficiency and pertinence**: more effort should be made for projects to include new user communities in areas of research outside of traditional user groups in order to promote interdisciplinary approaches.
- **Strengthening of impact**: if Community actions aim for longer-term impacts to become a reality, research consortia should be encouraged to think about their wider relevance to society, industry and European policy-making. This could be done during project planning and further encouraged via targeted support actions.
- **Enhancing European Added Value:** to reinforce EAV, the Commission should invest in activities similar to I3 that capitalise on the effect of networking within a wide consortium of partners and as part of a mix of joined-up activities.
- **Enabling further structuring**: NMS participation in projects should be promoted and their visibility increased as this encourages national investment in research at national level in these countries.

Overall, following this study, it is recommended that impact measures are developed to better measure the impacts of future actions. This would include the establishment of a set of objective impact measures for which time-series data are developed.

1. Structure of the report

This report is divided into seven sections. Sections 1 and 2 briefly discuss its structure and the purpose of the study. Sections 3 and 4 highlight the wider policy context and introduce the types of project that were funded via the Commission support actions. Section 5 briefly describes the methodological approach of the evaluation. Section 6 explains the main findings from the evaluation and Section 7 concludes with key recommendations.

The more detailed information about methodologies and the broad study findings, including impact and economic analysis, are preserved in the Technical Appendices.[2]

2. Study purpose

The impact assessment of EU support actions to RIs under the Sixth Framework Programme for Research (FP6) was undertaken retrospectively in order to assess the performance of the programme in relation to pertinence, impact, added value and structuring effect. The study also aimed to provide recommendations for future Community actions on the RIs.

3. Introduction to the Sixth Framework Programme and support actions

3.1. SIXTH FRAMEWORK PROGRAMME

FP6 ran from 2002 to 2006 as the Commission's frame for a set of instruments and priorities for research, technological development and demonstration. Its purpose was to foster research and innovation in Europe with a wider goal of strengthening the European-wide research community as a whole.

FP6 was to contribute to the creation of the European Research Area (ERA) by improving integration and coordination of research in Europe. There was also a wider ambition that research should strengthen the competitiveness of the European economy, including helping to solve major societal questions and supporting the formulation and implementation of EU policies.[3]

3.2. RESEARCH INFRASTRUCTURES UNDER FP6

The ability of Europe's research teams to remain at the forefront of all fields of science and technology depends on their being supported by state-of-the-art infrastructures. Accordingly, the use of RIs should be aimed at optimum level on a European scale, based on the needs expressed by the research community. It was envisaged these objectives would be achieved by:

i. enhancing existing infrastructures
ii. ensuring access to the infrastructures irrespective of their location
iii. providing support for the development of new RIs.

Effectively, RIs are seen as an essential tool for the development of leading-edge research in Europe and fostering the creation and diffusion of knowledge.[4]

The 83 projects evaluated in this study received in total €677 million. Overall, the total funding provided under FP6 represented about 4–5% of the overall expenditure on research and technology development in EU Member States. [5]

3.2.1 Project implementation instruments

The FP6 RI programme was implemented through three instruments[6]:

1. Integrated Infrastructure Initiatives (I3)
2. Coordination Actions (CA)
3. Specific Support Actions (SSA).

I3 combined within a single contract three activities[7]: networking activities, provision of access to transnational users and joint research activities. Networking activities were aimed at catalysing the mutual coordination and the pooling of resources among the consortium. Transnational access provided access to a group of infrastructures in a coherent manner, so as to improve the overall services available to the research community. Joint research activities supported the implementation of one or more

2 Matrix Insight and Rambøll Management (2009), Community Support for Research Infrastructures in the Sixth Framework Programme: Evaluation of Pertinence and Impact, Technical Appendices. Available at: http://ec.europa.eu/research/infrastructures

3 European Commission (2002), The Sixth Framework Programme in Brief, http://ec.europa.eu/research/fp6/pdf/fp6-in-brief_en.pdf.

4 European Commission (2004), Work Programme for the Specific Programme for Research, Technological Development and Demonstration 2002-2006,,ftp://ftp.cordis.europa.eu/pub/fp6/docs/wp/sp2/s_wp_200209_en.pdf.

5 European Commission (2001), Working Document of Commission Services: A European Research Area for Infrastructures, ftp://ftp.cordis.europa.eu/pub/improving/docs/infrastructures_sec_2001_356.pdf.

6 For further detail about the instruments, please refer to European Commission (2004), Work Programme for the Specific Programme for Research, Technological Development and Demonstration 2002-2006, ftp://ftp.cordis.europa.eu/pub/fp6/docs/wp/sp2/s_wp_200209_en.pdf.

7 Notwithstanding, five I3s with two of the three elements were initially funded.

joint research projects aimed at improving, in quality or quantity, the service provided by existing infrastructures. In the case of e-infrastructure projects, specific service activities were also provided with the goal of ensuring continued provision and upgrading of the required infrastructure-related services.

The CAs were limited to networking activities. They specifically sought to support the creation of more ambitious initiatives and were aimed at enhancing mutual coordination and pooling of resources.

SSAs included activities that ranged from conferences, seminars and working groups to feasibility studies and complex analyses.

3.2.2 Integrating Activities projects

The overall objective of Integrating Activities (IA) was to support the integrated provision of infrastructure-related services to the research community at European level. It was also intended to have a structuring effect on the fabric of European research by promoting the coherent use and development of infrastructures in the fields it covered. To that end, the main characteristic of IAs was their capacity to mobilise a large number of stakeholders. The ambition of an IA was to induce a long-term integrating effect on the way RIs operate, evolve and interact with similar infrastructures and with their users, thereby contributing to the structuring of the ERA.[8] 32 projects in the IA scheme were implemented as I3 projects and 10 projects as CAs.

3.2.3 Communication Network Development - e-infrastructure - projects

The aim of the Communication Network Development (CND) projects – i.e. e-infrastructure projects, –was to create a denser network, in particular by establishing a high-capacity and high-speed communications network for all researchers in Europe. The goal was also to produce specific high-performance grids and test-beds, as well as electronic publishing services.[9] In general, this scheme was concerned with the development of e-infrastructures for research capitalising on new computing and communication opportunities. The idea was also to further extend and deepen collaboration among researchers in Europe and beyond.[10] Most of the e-infrastructure projects were implemented as I3s, and specific activities limited to networking that were aimed at enhancing the mutual coordination and the pooling of resources were supported through CAs. Effectively, e-infrastructure projects were very similar to IA projects described above, with the main difference being that e-infrastructure projects were based on virtual infrastructures. 11 projects in the e-infrastructure (CND) scheme were implemented as I3 projects and 2 projects as CAs.

3.2.4 Design Studies

Design Studies (DS) related to future facilities of worldwide relevance that were not found in Europe. They were primarily feasibility studies or concerned with technical preparatory work for future infrastructures. More specifically, the feasibility studies aimed at laying the conceptual foundations of potential new or enhanced infrastructures, whereas technical preparatory work covered the development and testing of components, materials or techniques (including dedicated software) that were critical for the future development of new or enhanced infrastructures.[11] All the 19 projects in this scheme were implemented as SSAs.

3.2.5 Construction of New Infrastructures

The objective of Construction of New Infrastructures (CNI) was to optimise European infrastructures. Limited support for the development of a restricted number of new infrastructures was available. This was done in cases where such support could have a critical catalysing effect in terms of EAV.[12] All the nine projects in this scheme were implemented as SSAs.

3.2.6 Criteria for the evaluation of proposals

The Commission invited proposals via several calls from any area of science and technology including social sciences without a pre-determined allocation of funding to different areas. In this respect, the programme followed its tradition from previous Framework Programmes of being 'bottom–up'. The exception to this was the specific budget allocated for GEANT. The proposals were evaluated at a single stage by independent experts appointed by the Commission. Each type of support scheme (see above) had slightly different weightings and criteria, but the principle was that all proposals had to pass a threshold score under each category in order to be eligible for funding. For the I3 projects, the categories were relevant to the objectives of the Integrating Activitiy scheme, networking activities, transnational access activities, and joint research activities. Within these headings, long-term sustainability and structuring effect, quality of the management, science and technology (S&T) excellence, dissemination and use of results and EAV were judged explicitly. For the e-infrastructure I3 evaluation, the potential impact was weighted at 20%, with the same

8 Ibid.

9 http://cordis.europa.eu/infrastructures/activities.htm

10 European Commission (2004), Work Programme for the Specific Programme for Research, Technological Development and Demonstration 2002-2006,, ftp://ftp.cordis.europa.eu/pub/fp6/docs/wp/sp2/s_wp_200209_en.pdf.

11 http://cordis.europa.eu/infrastructures/ds.htm

12 http://cordis.europa.eu/infrastructures/cni.htm

weightings given to quality of management and mobilisation of resources alongside S&T excellence and relevance to the objectives of the scheme. The EAV for the Design Studies and Construction of New Infrastructures included the needs of potential users. The proposal selection was based on far wider criteria than S&T excellence alone.

3.2.7 Performance management and monitoring criteria

Commission staff project officers monitored the projects, typically following those in their own area of S&T expertise. Performance was measured against the milestones and deliverables in the agreed work programme of each project, which also incorporated a mid-term review with independent external experts.

3.2.8 Description of projects included in the study

This evaluation included 83 projects covering a range of research domains. The breakdown of projects across the schemes and implementation instruments is indicated in Table 1 below.

On average, the level of EC funding received by the 83 projects was nearly €8.5 million, varying from less than €0.5 million to more than €90 million. To some extent this variation was associated with the type of project:

- In both absolute and relative terms, I3 projects tended to receive more EC funding than SSA or CA projects.
- The average EC funding was greatest for e-infrastructure projects – at about twice as much as the EC funding received by CNI projects and Integrating Activity projects, and three times that received by DS projects. However, the larger overall size of CNI projects meant that EC funding made up a much smaller proportion of their total funding.

The number of participants in each of the projects varied from 1 to 90. On average there were 18 participants per project with the I3 projects including the highest number of partners. The duration of the projects varied from 2 to 5 years. In general, the e-infrastructure projects were the shortest but there was no clear difference between the other types of project. Overall, the first projects finished in 2006, whereas the final projects are not due to finish until 2011. Most projects are scheduled to finish in 2009.

Table 1: Description of projects included in the study

FP6 RIs –-Number of projects by scientific domain and support scheme							
Scientific domain	Integrating activities		Communication Network Development – e-infrastructures		Design studies	Construction of new infrastructures	Total
	CA	I3	CA	I3	SSA	SSA	
Astronomy, Astroparticles and Space Technology	3	3			4	1	11
Physics, Material Sciences and Analytical Facilities	2	4			3	1	10
High Energy and Nuclear Physics		5			3	1	9
Engineering, Energy and Nanotechnologies		4			2	1	7
Environment and Earth Sciences	3	6			2	1	12
Life Sciences and Biotechnologies	2	5			3	3	13
ICT – e-infrastructures			2	11			13
ICT and Mathematics		2			1		3
Socio-economic Sciences and Humanities		3			1	1	5
Total	10	32	2	11	19	9	83

4. Policy and context

4.1. THE EUROPEAN RESEARCH AREA

The notion of a 'European Research Area' (ERA) was proposed by the Commission in 2000, to encourage moves towards a European space for research where there would be mobility of researchers, coordination of funding and policies between Member States, an improved efficiency of research and a reduction in the fragmentation of European research resulting from nationally dominated policies, employment laws and research funding. Designed in response to the ERA vision, FP6 placed more emphasis on integration and coordination of research, compared with FP5. RI actions were placed within the domain "Structuring the ERA" within FP6. They encouraged nationally based infrastructures and facilities to collaborate with each other within a new instrument (the I3 projects) and other Integrating Activities, which had explicit objectives around creating EAV and structuring effects to work towards the ERA vision. The ERA was opened to a public consultation in 2007, and new developments have placed it as one of the pillars of the Lisbon strategy for achieving competitiveness, growth and employment in Europe. RIs remain a key part of the re-launched ERA.

4.2. THE EUROPEAN STRATEGY FORUM ON RESEARCH INFRASTRUCTURES

The European Strategy Forum on Research Infrastructures (ESFRI) was established in 2002 following initiatives by the European Council and Commission and key actors, stimulated by the ERA vision and the specific contributions which RIs would need to make to it. ESFRI is a forum for national representatives to coordinate policy and is not part of the Commission, although it has been supported by Commission staff in its workings. The most significant activities have been the development of the Roadmap, where an agreed list of RIs of pan-European importance was published in 2006, representing the outcome of organised consultations with scientists and users. The Roadmap did not affect FP6 in terms of its content, but it did raise the profile of RIs in Europe as a policy issue and produce much networking activity between researchers and policy-makers at its large conferences.

4.3. RESEARCH INFRASTRUCTURES IN FP7

Actions concerning RIs continue to be even stronger under the Seventh Framework Programme (FP7) (2007-2013). Many of the projects funded under FP6 sought follow-on funding in FP7. During the latter, RIs come under the 'Capacities' area, with the aim of promoting the best use and development of RIs in Europe. The bottom-up approach remains but is superimposed by a strategic approach, in which a list of priority projects for Europe (influenced by the ESFRI roadmap) may gain RI programme funding for a preparatory phase of planning followed by support for implementation in which EC funding acts as a catalyst for leveraging other funding.

4.4. PREVIOUS STUDIES

The current study is significant in that this is the first time that an ex-post evaluation and impact assessment of support actions for RIs at European level has been conducted.

5. Approach

The study followed a before-after evaluative framework for the systematic assessment of impact and pertinence and used a mix of methods for the collection and analysis of evidence.

5.1. RESEARCH QUESTIONS

The main evaluation questions[13] that the study set out to answer are listed in the table below:

Table 2: Main research questions

Objectives	Indicators
1. To make an analysis of the pertinence of the schemes used under FP6 to support RIs	1.1 To what extent were the objectives of the programme regarding RIs achieved? 1.2 Was the level of funding appropriate? 1.3 Were the scientific areas covered appropriate? 1.4 Were the modalities for programme implementation appropriate?
2. To gain an overview of the impact that the European Community actions, carried out in this field (i.e. FP6 support to RIs) have had on RIs, scientific communities and research policies	2.1 What impact – planned, unexpected, unintended - have Community RI activities had on scientific communities? 2.2 What impact – planned, unexpected, unintended - have Community RI activities had on research policy? 2.3 What impact – planned, unexpected, unintended - have Community RI activities had on the economy and industry? 2.4 What impact – planned, unexpected, unintended - have Community RI activities had on wider society?
3. To assess the added value of European action	3.1 To what degree did the implementation of the RI programme under FP6 lead to the generation of EAV? 3.2 What would have happened if no EU funding had been provided?
4. To analyse the structuring effect of supported actions with regard to the ERA	4.1 To understand whether the FP6 support to RI is, in itself, furthering and strengthening integration of research at European level.
5. To provide the Commission with recommendations for further Community actions regarding RIs	5.1 Provide strategic advice about the sectors and actions that can best deliver the Commission's desired objectives.

5.2. MAIN METHODS USED

Overall, the work carried out in this study had two main foci: the first was to establish the appropriate measures of impact, whereas the second larger focus was to assess the extent to which impacts had been achieved.

The activities undertaken to determine and assess appropriate impact measures included:

- scoping interviews with Commission staff
- a two-round Delphi survey[14] of experts in the field of RIs in Europe
- a review of descriptions of work for the 83 projects
- a Rapid Evidence Assessment[15] of relevant literature.

The activities undertaken to evaluate the extent to which the FP6-funded projects had achieved their desired impacts included:

- a project survey of all participants of the 83 projects
- structured interviews with coordinators and participants of 30 case study projects selected via stratified random sampling to ensure representativeness
- bi-variate and multivariate regression analyses for impact and economic analysis purposes.

The methods used above contributed to a number of key outputs:

- Impact measures: these included measures of the efficiency of RI services, integrating effect on science communities, impact on research policies and influence on economic, industrial and societal impacts.

13 See Terms of Reference for more information.

14 The Delphi method is a form of group communication used to explore ideas within a geographically dispersed panel of experts. The purpose is to obtain insights of experts and use their informed judgements as systematically as possible to draw conclusions in a problem area. For more information on how it was applied in this study, please refer to technical appendices, Appendix A.

15 Rapid Evidence Assessments provide a balanced assessment of what is already known about a policy or practice issue, by using systematic review methods to search and critically appraise the academic research literature and other sources of information. For more information on how it was applied in this study, please refer to Technical Appendices, Appendix A.

- Theory of change: this incorporated the mapping of FP6 logic towards achieving impacts.
- Descriptive analysis: this included the analysis of the project survey and case study results.
- Impact analysis: this comprised regression analyses of FP6 elements towards achieving impacts.
- Economic analysis: this constituted regression analysis of the impact of EC funding towards achieving impacts.
- Programme level analysis: this comprised of synthesising all key findings and contextualising them within the FP6 objectives.

5.3. KEY LIMITATIONS

The evaluation was faced with some limitations that are described below.

5.3.1 Programme limitations

The projects covered by the impact assessment were diverse, starting at different times. This had two main implications for the study:

1. At the time of the evaluation, projects were at different stages of completion. In this respect those that were closer to being completed may have been in a more advantageous position of being able to claim achieved impacts.

2. Some of the impact measures used in the study were more relevant for active RIs and were not fully applicable for those currently being designed or constructed.

The evaluation has, however, endeavoured to account for these factors in the programme-level analysis.

5.3.2 Methodological limitations

The methodology that the evaluation team adopted was constrained by the following factors:

- The evaluation was a retrospective impact assessment without control group. Thus, the research design was limited in its ability to measure the counterfactual (i.e. what would have happened in the absence of FP6 funding?).

- The impacts measured were self-reported assessments of recipients of EC funding.

- The sample size was limited to 83 projects, meaning that some caution applies to the statistical assessment even when results reported were statistically significant.

- The impact and economic analyses used bi-variate and multivariate models. The explanatory power of bi-variate analysis is limited as it does not control for other factors that may influence impact.

- The economic analysis is restricted to an assessment of the relative efficiency of FP6 projects, and is not able to assess whether the FP6 has been a good use of public resources.

5.4. EVALUATION

The evaluation was carried out by Matrix Knowledge Group in cooperation with Rambøll Management and PREST between July 2007 and March 2009.

6. Findings

6.1. PERTINENCE OF THE RESEARCH INFRASTRUCTURES PROGRAMME

There was clear evidence that the FP6 programme was pertinent in meeting its objectives in relation to the needs of the research community. 90% of the projects included the most relevant partners according to the project co-ordinators.[16] The amount of EC funding was also viewed as appropriate in meeting project goals for just over 60% of the projects and appropriate for meeting the needs of the scientific communities in a little over 50%. However, the 'bottom-up' nature of the projects meant that some of the wider aspirations for the programme in relation to making a broader economic and social impact have not been realised.

6.1.1 Meeting project objectives

The majority of the projects had either fully met the original need they set out to address or had exceeded this need. Very few projects could have undertaken all their current or past activities without the Commission funding. Projects often reported that the activities would have been partly undertaken in the absence of EC funding.

A majority of projects had sought user feedback. This had little influence on the way in which the project operated and was particularly a requirement for the I3 projects.

The partners chosen for projects were relevant and appropriate. In a majority of cases, partners with the best expertise in the field were selected to safeguard the success of the projects. Often these partners were already known to the project consortia and in this way previous relationships were important for establishing the project consortium.

Organisations taking part in the FP6 projects had to a large extent fully met their objectives from the participation. This is shown in Figures 2 and 3 below.[17]

16 The most relevant partners were considered to be those that had a specific expertise in the field.

17 Please note that 'project scheme' refers to the four support schemes under FP6. These support schemes funded specific activities with policy related goals (see p.13–14 of this report). In contrast, 'project instrument' refers to the forms of support that are available via the four schemes. They describe the way in which these support schemes are implemented and how the support within these schemes is organised (see p. 12–13 of this report). Please also note that two of the support schemes (IA and CND) were implemented via two forms of support, as I3s and CAs. The other two schemes (DS and CNI) were implemented as SSAs only.

Figure 2: Organisations having fully met their objectives by project scheme (%)

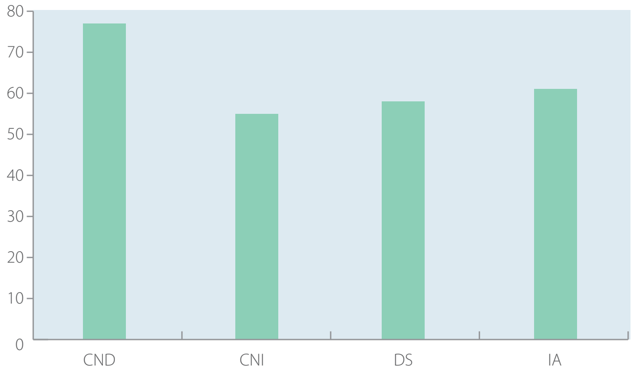
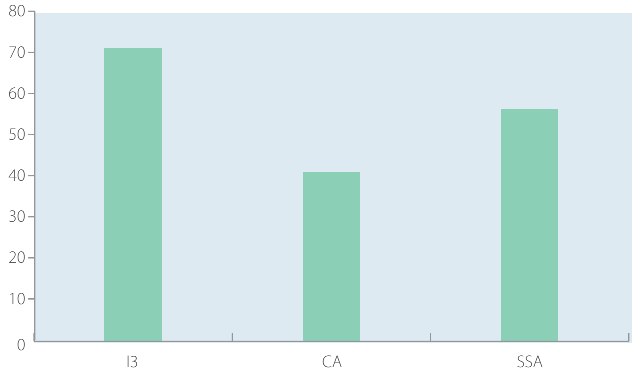


Figure 3: Organisations having fully met their objectives by project implementation instrument (%)



The figures show that e-infrastructure (CND) projects were most likely to have fully met their objectives. Of the research instruments, I3s were most likely to have done so. Across scientific domains, the differences in objective achievement could be explained by the 'maturity' of the scientific fields in terms of European cooperation and networking in infrastructures, with the Physics, Materials Science and Analytical Facilities domain showing a higher level of objectives achievement than Environment and Earth Sciences.

In general, the factors contributing to meeting projects' objectives were most commonly identified as 'shared vision and commitment' from the project consortia and the quality of staff associated with the project.

6.1.2 Sustainability of projects

The Commission covered over half of the cost of 73% of all projects, with the majority of these being I3s. In addition, some of the partners invested additional resources (funding and effort) into the projects. These additional resources invested ranged from 0 to over 100% of the original budget.

Overall, the Commission funding was viewed as essential for starting the projects and achieving its objectives. Many project coordinators reported that their organisations had applied specifically for FP6 infrastructure funding because no other viable sources of funding exist for these types of project.

Findings from the qualitative case studies revealed that, in many instances the realisation of FP6 project impacts was contingent to some or a strong degree on other funding or follow-on funding from the Commission. Many projects had secured follow-on funding either for continuing the project itself or certain aspects of it. Where EC funding was not renewed or extended, the coordinators were of the view that what had been achieved could not be sustained. Those projects lacking prospects of European-level funding were unlikely to maintain any form of EAV after the end of the project.

The majority of all projects had also been subject to some form of internal or external assessment. There was evidence of such assessment leading to a low level of change in a minority of all projects. It is apparent that these projects had delivered what they set out to do to a high standard.

6.1.3 Wider programme-level aspirations

The projects as a whole have been less pertinent to meeting the wider and more ambitious objectives of FP6. This has only materialised in isolated cases where there are examples of societal, economic and industrial benefits. Examples of these impacts are included in the report. Overall, most of the impacts in these areas were outside the direct influence of the projects and depended on market conditions. Moreover, the more ambitious impacts will take a much longer time to materialise and could therefore not be captured by this evaluation. There was anecdotal evidence only of projects having had a systemic impact on the attraction or retention of scientists in Europe. Besides the odd scientist achieving a fixed tenure as a result of the projects, most employment effects were temporary and linked to the project duration. If anything, the cases studies identified a slight effect of scientists moving to industry.

Conclusions and overall assessment

The sustainability of project outcomes – particularly at European level and beyond – generated with European-level support have been, and continues to be, curbed by limited follow-on funding to support transnational and international RI cooperation particularly from national funding sources. Even the best performing projects are reliant on continuous support from European institutions to sustain cross-border cooperation.

Wider societal, economic, and industrial impacts are not associated with these projects at present. However, some projects have the potential to realise them in the future.

6.2. IMPACT OF THE RESEARCH INFRASTRUCTURES PROGRAMME

6.2.1 Impact on Research Infrastructures

90% of all projects anticipated impacts on RIs at the start of the project. The results below indicate the extent to which these objectives were met – i.e. impacts on RIs achieved – and what factors positively influenced their achievement.

6.2.1.1. Programme objectives and expectations of impact in relation to Research Infrastructures

In order to assess the achievement of impact in this area, it is important to understand what the programme set out to achieve. One of the overall objectives of the FP6 Infrastructures programme was to promote the development of research infrastructures of the highest quality and performance (Work Programme (2004-2006), 30 March 2005). The work programme also specified that there would be support for a European approach for the operation and enhancement of existing infrastructures. Although the importance of impacts on RIs varied according to the type of project, it was relevant to all project types over the longer term.

In the selection of I3 project proposals, the networking activities and joint research projects were expected to demonstrate enhancement of RI services and impact on related infrastructures, for example by spreading good practice and common protocols. These would have been expected to materialise fairly quickly if the projects were successful. It was therefore anticipated that projects would carry out research to explore new technologies and/or techniques underpinning RI use and improving RI services. Impact in these areas might therefore be expected to be visible only in the longer term since ‘fundamental technologies’ and ‘innovative research’ would require more time and effort in order to be translated into impacts, for example by implementing new instruments.

The e-infrastructure I3s were selected to promote the optimum development of RIs through high-speed, high-capacity networks and Grids, which in turn, would underpin the development of improved RIs in different disciplines. They were also concerned with coordinating national bodies (e.g. National research and education networks – NRENs and national Grids) and so were expected to have had an impact on RIs at national level, for example by sharing good practice and protocols and via integrating services. This kind of impact would have been expected to materialise fairly quickly in terms of improvements to RIs.

The Design Studies did not have impacts on RIs as a selection criterion, but were concerned with future improvements, while the Construction of New Infrastructures, mainly aiming at EAV, included improved services in their objectives. These might have been expected to develop fairly quickly assuming that new RIs were built during the programme. SSAs – being a flexible instrument to contribute to the implementation of the programme and/or dissemination of results – could in theory have had an impact on RIs as a main objective and a hence would have been likely to achieve ‘quick’ results, depending on the nature of the project. Thus, impact on RIs was of central relevance to the I3s – both Integrating Activity and e-infrastructure projects, as well as to Construction of New Infrastructures projects and of less relevance to the other CAs and SSAs.

6.2.1.2. *The predictors of key impacts*

Within the FP6 RI projects, certain factors were positively associated with the achievement of impacts on RIs. The summary of key impacts in this area is shown in Table 3 below. The table describes the area of the impact, the specific impact type and the factors that were found, through rigorous statistical analysis, to be associated with impacts in each area. It also describes whether or not these impacts related to the structuring of the ERA or EAV.

Table 3: Description of factors associated with impact

Model parameters		
Impact on	Type of impact	Factors associated with impacts
Standing and visibility of European RIs and research	**Increase in the quality of RI services as a result of the FP6 project**	I3 project vs. other
		NMS partners involved vs. not
Service provision	**Partner organisations expanded services as a result of the FP6 project**	I3 project vs. other
		EC funding as % of total funding
Data sets, standards and protocols	**Increase in the quality of research data as a result of the FP6 project**	I3 project vs. other
		NMS partners involved vs. not
Speed of access and network capacity	**Increase in the remote use of RI**	EC funding as % of total funding
Attraction, retention and repatriation of scientists and researchers	**Increase in the number of young researchers working in partner institutions as a result of the FP6 project**	NMS partners

Note: Each of the associations reported in the table were found to be statistically significant to the extent that there is only 5% probability that they occurred by chance.

In summary, these findings (as referred to in the table above) indicate that:

- I3 projects were more likely to produce better quality RI services, better quality research data and more services offered by the RI facilities.
- A high proportion of Commission funding, in relation to the total project budget, was associated with an increase in the remote use of the RI facility and the expansion of services offered by the RI facilities.
- The presence of New Member States (NMS) in the project consortia was associated with a rise in the number of young researchers working in partner institutions, in the quality of RI services and in the quality of research data.

From the perspective of the FP6 RI programme, these findings indicate that some of the key components of the programme were indeed associated with the delivery of impacts. Moreover, these were related to the added value of European action and strengthening of the ERA.

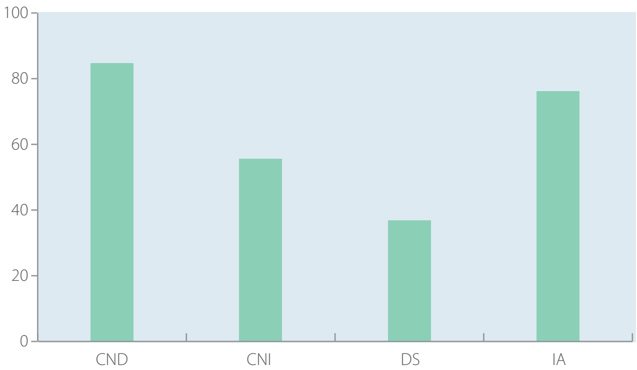
6.2.1.3. *Strength and variability of the key impacts*

This section describes the strength and variability of the key impacts described above, in particular how these varied according to the schemes supported under FP6 (Design Studies, Construction of New Infrastructures, e-infrastructure (Communication Network Development) and Integrating Activities) and the research instruments through which they were implemented (Integrated Infrastructure Initiative, Specific Support Action, and Coordination Action). The results are purely descriptive and place the above impact findings into a wider context. The overall purpose is to describe impacts on RIs at programme level.

The quality of RI services

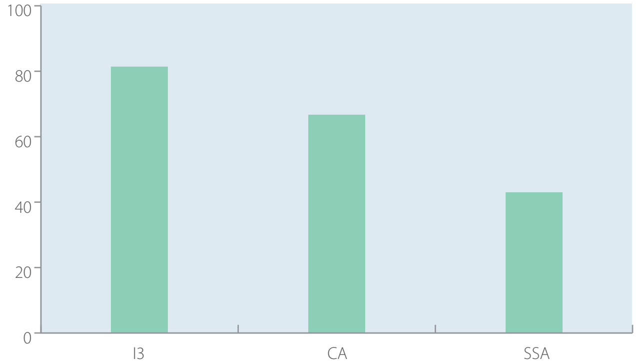
There was clear evidence that the quality of RI services had increased as a result of FP6. This was the case for 55 (66.3%) of the projects. This was most pronounced within Environment and Earth Sciences, ICT e-infrastructures, Physics, Material Sciences and Analytical facilities and Socio-economic Sciences and Humanities. The extent to which the quality of RI services had risen also varied between the schemes supported under FP6 and the associated research instruments. This is indicated in the figures below. Figure 4 indicates that IAs and e-infrastructure (CND) projects in particular have been able to increase the quality of the services they offer. Of the research instruments (see Figure 5), the I3 projects were most likely to have improved the quality of RI services. SSA projects were the least likely to have done this, which is not surprising given their purpose.

Figure 4: Increase in the quality of RI services by project scheme (%)



In addition, clear evidence was found that the quality of research data had grown as a result of FP6 as 51 projects (61.4%) reported this. This impact was highly relevant for all projects with little variability across the schemes supported and the research instruments whilst most prominently occurring within the I3 projects. Of the research fields, increase in the quality of research data was most relevant for High Energy and Nuclear Physics and Physics, Material Sciences and Analytical facilities.

Figure 5 : Increase in the quality of RI services by project implementation instrument (%)



CASE STUDY EXAMPLES: Quality of research

- The Baltic Grid (I3) project developed an entirely new grid in the Baltic States from scratch. This had a profound impact on the quality of research that the users were able to undertake as a result. Not only were researchers now able to undertake more complex and internationally competitive research, they were also able to achieve large efficiency gains by increasing the quality of their outputs many times over while at least halving the time spent on analysis.

- The EUSAAR (I3) project made a large investment to define the proper formats for data storage and exchange, to give each partner the right tools for data transfer procedures and to implement the most suited tools for visualisation and extraction of data in response to user requirements.

Expanding the range and coverage of RI services

The evidence suggests that projects had some level of impact on interdisciplinary research. Typically, better quality facilities allowed for tests and experiments by other disciplines to be undertaken, although these impacts also depended on developments and priorities within these disciplines. Despite this, improving access to European data repositories and archives for a range of beneficiaries was only a relevant impact for a minority of projects. Often access was restricted to the project partners and widening it was not a high priority.

An aim of FP6 was to expand the range of services offered to researchers. There is evidence that a majority of projects, 46 projects (55.4%), did indeed expand the services they offered. The extent and variation of this impact across the schemes and the project instruments, is shown in Figures 6 and 7 below.[18]

18 Please note that the size of the bubble indicates the size of the Commission funding whereas the y-axis shows the proportion of the projects who reported an increase in the quality of RI services. The x-axis denotes the actual number of projects underlying the reported increase.

Figure 6: Expansion of services by project scheme (%)

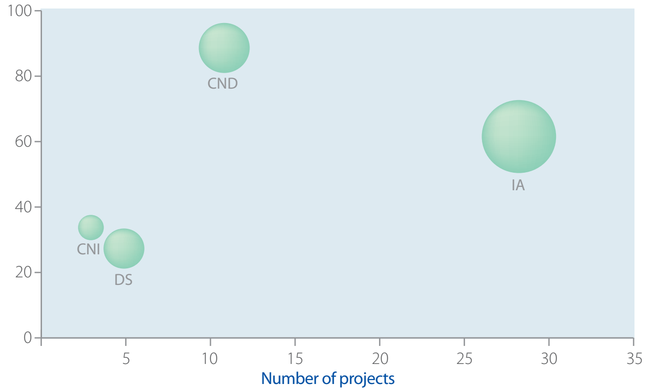
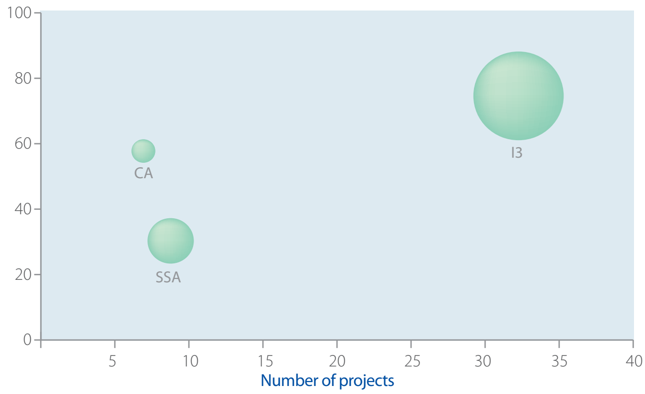


Figure 7: Expansion of services by project instrument (%)



It is evident from Figure 6 that e-infrastructures (CND) projects were the most likely to have expanded services. Of project instruments, I3 projects were the most likely to have increased the services they offered, followed by CAs. SSAs were the least likely to have expanded services. Given that this was not expected from them, the fact that almost 30% were able to expand services can only be regarded as positive. Of the scientific fields, expansion of services was most likely for ICT e-infrastructures and IAs covering Socio-Economic Sciences and Humanities, Physics, Material Sciences and Analytical facilities.

CASE STUDY EXAMPLE: Involvement of user groups

The Int.eu.grid (I3) project enabled access to new user groups within academia as well as the wider community beyond the High Energy Physics area traditionally supported via grid infrastructures. For instance, the grid was used to support applied research in the construction sector in the modelling of marine architecture, in managing the water supply for a regional water utility, and in analysing patient brain scanning data at a local hospital in the Cantabria region of Spain.

The improved standing of RIs

Overall, the strongest evidence of impact on RIs as a result of FP6 funding relates to the improved standing of European RIs and research.

There was evidence that FP6 had led to an increase in the number of young researchers working in the area of the project at partner institutions. This was relevant for 45 (54.2%) of the projects but varied across the schemes and research instruments as indicated in the figures below.

Figure 8: Increase in the number of young researchers in partner organisations by project scheme (%)

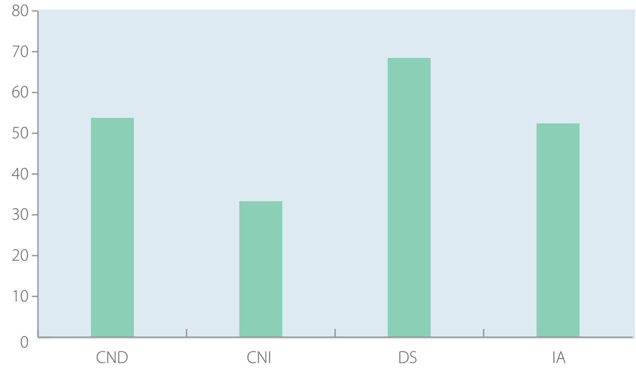
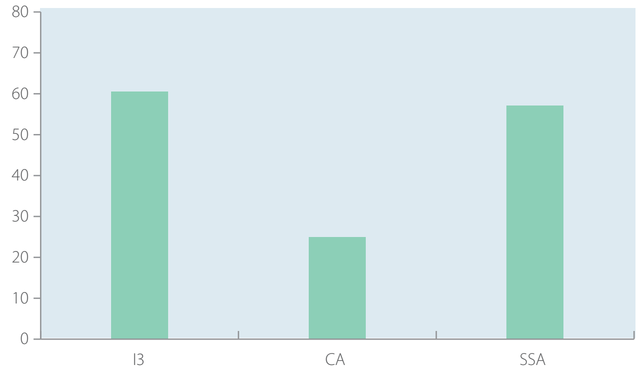


Figure 9 : Increase in the number of young researchers in partner organisation by project instrument (%)



As can be observed in Figures 8 and 9, the increase in the numbers of young researchers working in the project area at partner institutions was strongly evident except in CNI and CA projects. The rise in the number of young researchers was particularly prominent for Design Studies and for I3s overall. Of the research fields, the higher numbers of young researchers was most prominent within High Energy and Nuclear Physics, Physics, Material Sciences and Analytical Facilities and Socio-economic Sciences and Humanities.

As a whole, these findings indicate that young researchers were attracted to working in a transnational environment. At the same time, relatively few FP6 projects were found to have opened up facilities to new user communities.

CASE STUDY EXAMPLES: Improved standing

- The VO-TECH project is a Design Study for developing an international initiative that links astronomical data archives to a virtual observatory in Europe. The project has had a direct positive influence on the standing of European RIs through its work in the International Alliance of Virtual Observatory projects. It has also enabled access standardisation protocols to be developed that have been implemented internationally.

- Through the EuroCarbDB Design Study, Europe has clearly taken the lead in Glycoscience and Glycoscience RI. This is recognised by American and Japanese partners.

- As a consequence of a practical strategy for improving the state of the infrastructure, several instruments have been upgraded during the first two years of the EUSAAR (I3) project. This led to the definition of a global strategy within EUSAAR to set common measurement standards, improve the infrastructure and provide a better integration of aerosol measurements.

- The GO4It (I3) project has strongly improved the visibility of the project partners outside of Europe. The consortium succeeded in attracting additional voluntary contributions from partners in China and South America.

Where such opening up had been achieved, this was mostly geared towards new geographical user communities rather than users from new scientific disciplines. Only anecdotal, non-quantifiable evidence was found about the impact of the scheme on the attraction and retention of scientists in Europe. If anything, the case studies indicated that scientists moved to industry. Arguably projects would be expected to have little influence on outcomes such as retention given that it will depend on other factors external to the projects themselves such as national R&D structures and market conditions.

CASE STUDY EXAMPLE: Young researchers

Direct beneficiaries from the EURONS (I3) project were funded PhD students and Post Docs. A large contribution was made to the educational development of these young researchers providing them with opportunities to develop skills, disseminate results and take part in the physics community. The involvement of young researchers helped increase the sustainability of knowledge and diversity of the research community, at different levels, within the participating universities, which in turn has helped to optimise conditions for the production of high-quality scientific results.

Remote access and speed of access to RIs

One aspect becoming increasingly relevant for RIs in a global environment is their ability to be able to provide remote use of aspects of their services to users scattered across the globe. Overall, little evidence was found to suggest that FP6 had resulted in a universal increase in the remote use of RIs as this was only found to have been the case for 18 projects (21.7%). However, this outcome was of particular relevance for e-infrastructure projects as 61.5% of these had indeed boosted the remote use of the RI. End-user speed of access to outputs was a priority and an important factor in achieving project objectives for many of the projects beyond those in e-infrastructure although little evidence was found to suggest that supporting information and communication technology (ICT) factors, such as speed of connection or increased capacity for data traffic over the network, had been achieved. Nonetheless, the speed of access to outputs is not necessarily facilitated by ICT factors – many RI users would not be aware of changes to speeds and/or capacity, nor would they be able to attribute it to a particular e-infrastructure project.

CASE STUDY EXAMPLE: Remote access

The EGEE2 (I3) project has undoubtedly played a key role in developing European grids to enable e-science and remote access of researchers to world-leading RIs. It has had a role in helping and supporting other e-infrastructures projects also funded under the FP6 RI funding stream as well as supporting national grids in their development with a view to ensure sustainability of these RIs in future. EGEE2 has also been important for the standardisation of protocols across Europe and beyond to allow more users access to the capacity provided by these types of RI.

Quality of RIs in New Member States

The objective of increasing the quality of RIs in NMS has already been realised to some extent. Figures 10 and 11 indicate the types of project for which this was particularly relevant.

Figures 10 and 11 indicate that improved quality of RIs in NMS was predominantly related to Integrating Activity projects and in particular for those projects that were implemented as I3s. Although improvements in the quality of RIs in NMS have, to date, only been realised within a minority of projects, this impact is expected to be realised for just under half of all the projects in the future.

Figure 10: Improved quality of RIs in NMS by project scheme (%)

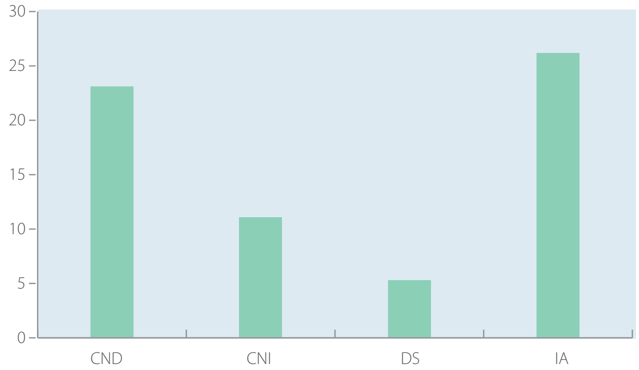
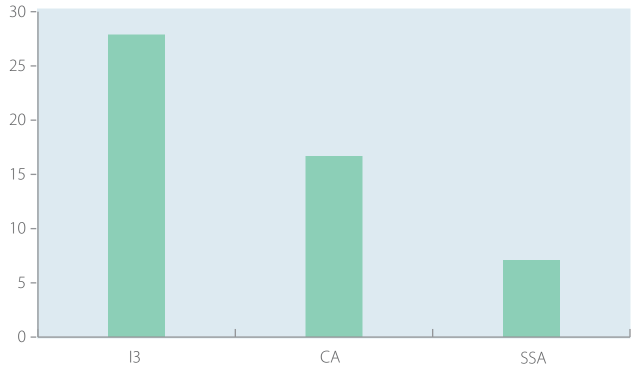


Figure 11: Improved quality of RIs in NMS by project implementation instrument (%)



CASE STUDY EXAMPLES: Improved quality of RIs in NMS

- The EGEE (I3) project, led by CERN with a Polish partner responsible for operations in Central Europe, has shown impacts on NMS RIs as well as beyond the EU. It is the world's largest multi-science grid infrastructure. It has had a unifying effect across Europe, created many virtual organisations and improved NMS e-infrastructures.

- The EUSAAR (I3) project reinforced existing infrastructures as new inlet systems and instrumentation were built in particular in NMS locations where access is now open to a larger scientific community. This extended access linked to a better quality control and inter-comparison of measurements had a very positive structuring effect.

Conclusions and overall assessment

Overall it is evident that there has been a very strong impact on RIs as a result of the FP6 programme. While this was an area where impact was expected to be achieved, on the whole, the scale and pervasiveness of the impacts on RIs at programme level were very high especially considering the timing of the evaluation (many projects were either ongoing or had recently finished at the point of this evaluation). This indicates that impact on RIs was achieved during, or at the end, of projects and it was realised particularly prominently by I3s together with project types (SSAs and CAs) which did not state it as their main aim.

6.2.2 Impact on science communities

92% of all FP6 RI projects anticipated impacts on science communities at the start of the project. The results below indicate the extent to which these objectives were met – i.e. impacts on science communities achieved, and what factors influenced positively their achievement.

6.2.2.1. Programme objectives and expectations of impact in relation to science communities

Achieving impacts on science communities was a key goal for this programme, since it sought to develop and enhance European RIs in order to improve European science. Effects on science communities were strongly expected, in terms of increasing the number of users through the transnational access activities (inside and outside Europe[19]) and training them, increasing the speed of access and network capacity and promoting networking and collaboration of researchers. For I3 projects, the networking and access activities were expected to demonstrate enhancement of RI services, for example by spreading good practice and common protocols and fomenting the creation of virtual or distributed facilities, where impacts on scientific communities would be expected fairly quickly if the projects were successful. Impact from the joint research might be visible only in the longer term. The Design Studies did not expect to have immediate impacts on science communities while the Construction of New Infrastructures included improved services in their objectives, but would require their implementation and use to achieve an impact here.

19 Please note that access to non-European users was mainly relevant for the Communication Network Development (e-infrastructure) projects given their nature and scope. The non-virtual research Infrastructures only covered the access costs of European users.

6.2.2.2. The predictors of key impacts

Certain factors were positively associated with the achievement of impacts on science communities. The summary of key impacts in this area is shown in Table 4 below.[20] The table describes the area of the impact, the specific impact type and the factors that were found, through rigorous statistical analysis to be associated with impacts in each area. As before, it describes whether or not these impacts related to the structuring of the ERA and whether they were directly linked to the added value from European Community involvement.

In summary, these findings (as referred to in Table 4) indicate that:

- ICT e-infrastructure projects were more likely to increase the number of non-European users of the RI.
- A high proportion of EC funding, in relation to the total project budget, was associated with a rise in the number of people receiving training in the use of equipment and the degree to which researchers are networked.
- I3 projects were more likely to enhance access as a result of better IT quality and they are also associated with growth in the number of people receiving training in the use of equipment.

From the perspective of the FP6 RI programme, these findings indicate that some of the key components of the programme are indeed associated with the delivery of impacts. Moreover, these are particularly related to the EAV.

6.2.2.3. Strength and variability of the key impacts

Increased networking of researchers

There was clear evidence that the degree to which researchers were networked in the area of science in which the project operated had increased as a result of FP6. This was the case for 66 (80.0%) of the projects. The extent to which researchers were networked varied between the schemes under FP6 and the research instruments. This is indicated in the below figures.[21] Figure 12 indicates that increases in the degree to which researchers were networked had been marked for all the schemes except for Construction of New Infrastructures. In particular, almost all IA and e-infrastructure (CND) projects saw a marked increase in this factor. This is encouraging given that the Commission specifically supported this activity within these schemes. Strengthening this proposition, two of the project instruments (CAs and I3s) were imperative in driving this increase in networking. This was expectedly lower for SSA projects because this was not so relevant for future infrastructures at present (see Figure 13).

Table 4: Description of factors associated with impact on science community

Model parameters		
Impact on	Type of impact	Predictors
End-users	**Increase in the number of non-European users of the RI**	ICT e-infrastructure projects vs. other
	Increase in the number of people receiving training of equipment as a result of the FP6 project	I3 project vs. other
		EC funding as % of total funding
Speed of access and network capacity	**Increased access to RI due to IT quality as a result of the FP6 project**	I3 project vs. other
Networking, exchange of good practice, joint working	**Increase in the degree to which researchers are networked as a result of the FP6 project**	EC funding as % of total funding

Note: Each of the associations reported in the table were found to be statistically significant to the extent that there is only 5% probability that they occurred by chance.

20 These findings are based on a logistic regression model where these predictors were found to be statistically significant at $p < 0.05$. For further detail please refer to the case study report.

21 Please note that the size of the bubble indicates the size of the Commission funding whereas the y-axis shows the proportion of the projects who reported an increase in the quality of RI services. The x-axis denotes the actual number of projects underlying the reported increase.

Figure 12: Increase in the degree to which researchers are networked by project scheme (%)

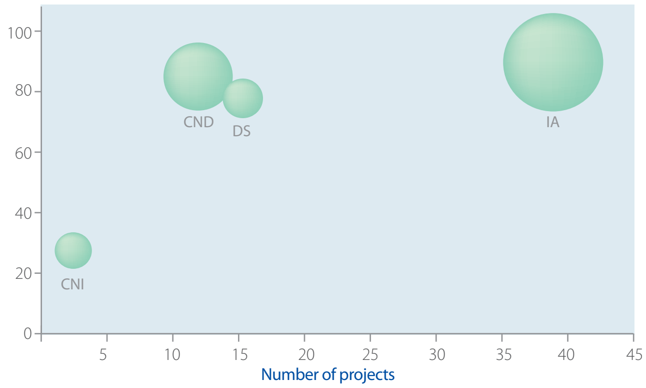
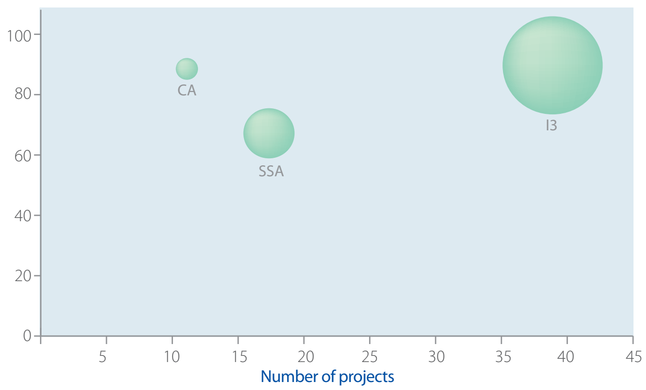


Figure 13: Increase in the degree to which researchers are networked by project implementation instrument (%)



> *CASE STUDY EXAMPLES: Increased networking of researchers*
>
> - By providing a platform for connectivity, the Geant2 (Multi-Gigabit European Academic Network) (I3) project had clearly led to increased networking of researchers. The participants included both NMS and applicant countries, and had generally allowed for improved quality and access to research for the scientific community across the ERA.
> - The EUSAAR (I3) project supported four important joint calibration exercises that concerned all partners of the networking activities. These workshops mobilised 20 different groups overall from the consortium with more than 200 participants. In addition 34 groups from outside the consortium were also mobilised.
> - As a result of networking in the EUDET (I3) project Poland and Czech Republic were better integrated in the consortium and consequently were considered stronger partners in the FP7 proposal

The increased networking brought specific benefits and also developed the ERA. The most vivid example of this is the fact that NMS had been able to undertake new types of research which was also of a higher quality. In addition, there had been growth in the number of integrated datasets in 40% of the projects. This was particularly prominent within IA and e-infrastructure (CND) projects. Among the project instruments, this was mostly related to the CAs. Moreover, most projects reported that the generation of new standards and protocols was relevant to them, although to date, most had not fully realised this aim.

Increased provision for training of users

Overall, one aim of FP6 was to support better service provision for a range of users. Access to critically important equipment was relevant for many projects and, within this access element, training of users was also provided. Many doctoral and post-doctoral researchers received training. There was evidence that half of projects (50.6%, n=42), did increase training for equipment received by researchers. The extent and variation of this impact across the FP6 schemes and project instruments is shown in the figures below.

Figure 14: Increase in the number of people receiving training of equipment by project scheme (%)

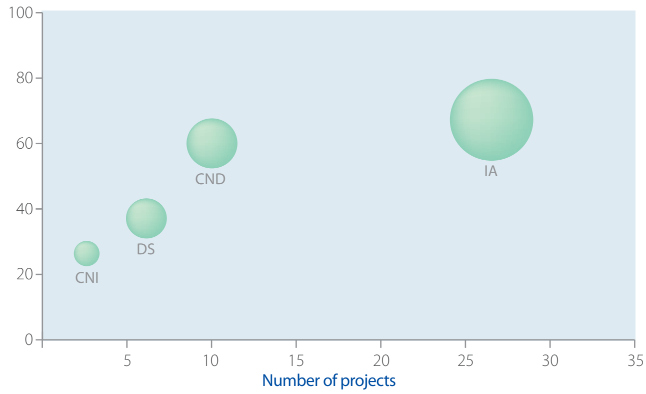
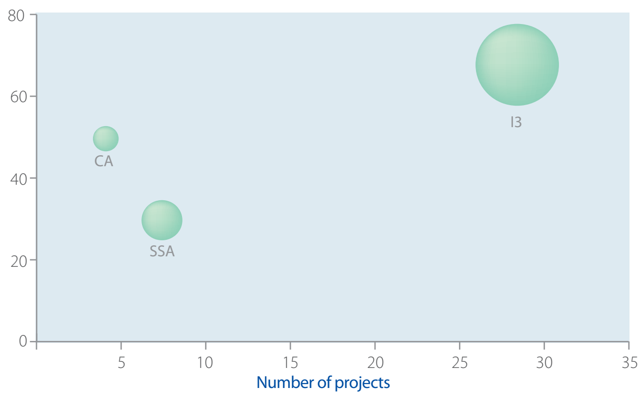


Figure 15: Increase in the number of people receiving training of equipment by project implementation instrument (%)



It is evident that training was equally prominent for IA and e-infrastructure (CND) projects, with just over 60% of them having increased the number of researchers receiving training. However, it is no surprise that this was less relevant for the other schemes. This finding is reflected at project instrument level where the I3s most actively supported training for a range of users. The qualitative assessment, facilitated through the case studies, provided further evidence that where users received adequate training in how to use the RI, they were much more able to deliver new and better scientific outputs as a result. For physical and virtual RIs, the availability of support (around the clock) including training, set some RIs apart from others in terms of the quality and quantity of research that they could facilitate. At the same time, the case studies suggested that training was perhaps too contained to specific user groups and that insufficient effort was invested in training new users from new user communities.

CASE STUDY EXAMPLES: Training of users

- The ITS LEIF (I3) project on ion beams has seen a high demand for training and the project results are being used to give state-of-the-art training in skills for atomic and molecular physics.
- The MAX-INF2 (CA) project had training as a core activity, mainly targeting younger scientists at PhD and Postdoctoral level. The courses were all heavily oversubscribed, suggesting a strong user demand for training.
- The NMI3 project trained 820 people through courses or workshops, mainly younger researchers, funded indirectly with a 94% satisfaction of trainees.

Increased access for users outside Europe

Projects provided strong evidence that the EU support actions had led to national RIs opening up to European and other international scientific users, although the impact beyond Europe was far less marked. Relatively few projects had opened up their RI facilities to new scientific user communities. Where such opening had been achieved, this was geared towards new geographical user communities rather than users from other scientific disciplines. Figures 16 and 17 below indicate the extent of opening to users outside Europe.

Figure 16: Increase in the number of non-European users of the RI by project scheme (%)

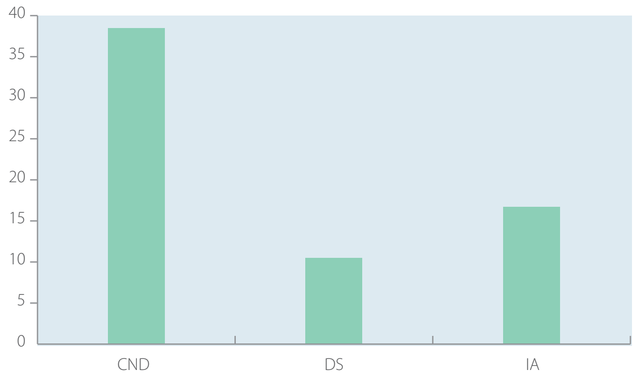
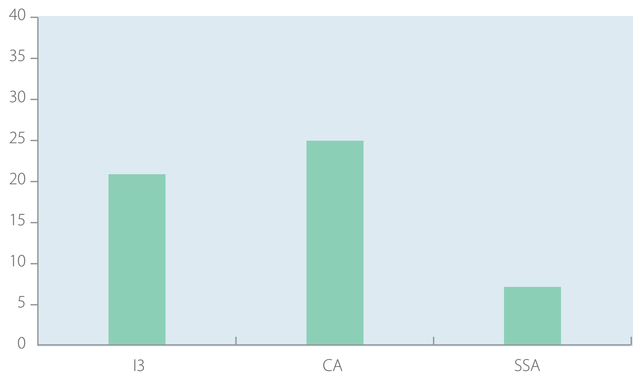


Figure 17: Increase in the number of non-European users of the RI by project implementation instrument (%)



Rises in the number of non-European users was mainly relevant for the e-infrastructure (CND) projects but not at all for CNI projects, which are not depicted in the above figures. Across the research instruments, an increase in non-European users was primarily relevant for CAs and I3s. Overall, given the fact that user data is often only collected at European level and that only European researchers could be funded for access, these results are

CASE STUDY EXAMPLE: Wide user access

The EUDET (I3) project, coordinated by DESY, undertook detector R&D for the next large particle physics project, the International Linear Collider, which will be a global collaboration. As well as 24 participants from Europe, including CERN, there were associated partners from several Russian institutes, China and Japan. The project developed infrastructure to facilitate experimentation and analysis and had two transnational access activities, one for the DESY test beam and one for the next-generation large-scale particle detectors. The high-precision beam telescope has attracted about half its users from Canada, China, Japan and the USA (and non-member Italian labs).

encouraging. Moreover, the quality of IT had an impact on increased access to the RIs. This was relevant for just over a third (35 %) of all the projects, in particular for the e-infrastructure scheme and the I3 projects. However, only a small number of projects reported that they had improved access to European data repositories or archives for a range of beneficiaries. In many projects, immediate access was reserved for the project consortium and the ensuing results disseminated via publications.

> ***Conclusions and overall assessment***
>
> Overall it is evident that FP6 has had a very strong impact on science communities in terms of increased networking, particularly for the e-infrastructure (CND) and IA projects. This networking goes beyond Europe, as does the increased access for science communities (in particular driven by the e-infrastructure projects.) The programme has also boosted the number of users by opening up national RIs to new geographical users and has increased the number of researchers receiving training in RI use, although more could be done in future to ensure that new user communities gain access to existing RIs. There was a positive impact upon RIs in NMS. More integrated datasets were found as a programme output. While this was an area where impact was expected, on the whole, the scale and pervasiveness of the impacts on RIs at programme level were high, and achieved during, or at the end, of projects.

6.2.3 Impact on research policy

65% of all FP6 RI projects anticipated impacts on research policy at the start of the project. The results below indicate the extent to which these objectives were met – i.e. impacts on research policies achieved, and the factors that influenced positively their achievement.

6.2.3.1. Programme objectives and expectations of impact in relation to research policy

Impacts in relation to research policy were expected, although implicitly rather than explicitly. This is because the programme sought to promote improvements in European RIs. The programme budget, although large in absolute terms, was very small in relation to national funding for RIs and communication networks across all Member States. Thus, the programme intended to generate a leverage effect in terms of RI development and the ERA, requiring national and regional policy decisions to fully realise the vision of the highest-quality fabric of RIs and their optimum use in Europe. The realisation of these impacts could be quick, for example, a decision to invest in a new RI by a Member State being directly influenced by the award of a Construction of New Infrastructures project. They might take longer to realise, for example securing national funding to allow European access and networking to continue after the FP6 project grant, or deciding to make a regional investment after a Design Study. The projects themselves anticipated impacts in relation to research policy. The I3 and e-infrastructure projects did not normally include a 'policy' element. The exceptions here were the SSAs which were intended to contribute to research policy through activities such as foresight and policy analysis of RIs.

6.2.3.2. The predictors of impacts on research policy

Within the FP6 RI projects, certain factors were positively associated with the achievement of impacts on national research policy. Only impacts at national level were statistically measured as it was expected that policy impacts at European and international level would be more marked in the future. The results are shown in Table 5 below. The table describes the area of the impact, the specific impact type and the factors that were found, through rigorous statistical analysis to be associated with impacts in this area. It also describes whether or not these impacts related to the structuring of the ERA and whether they were directly linked to the added value from European Community involvement.

Table 5: Description of factors associated with impact on national research policy

Model parameters		
Impact on	Type of impact	Predictors
Recognition of RIs in policy agendas	**More priority given to RIs in national research policies as a result of the FP6 project**	Progress towards project completion
		ICT e-infrastructure project vs. not

Note: Each of the associations reported in the table were found to be statistically significant to the effect that there is only 5% probability that they occurred by chance.

In summary, the findings (as referred to in Table 5) indicate that:

- As a project moved closer to completion, it was more likely that higher priority was given to RIs in national research policies.
- ICT e-infrastructures were more likely to increase the priority given to RIs in national research policies.

From the perspective of the FP6 RI programme, these findings indicate that policy impacts are created as the projects mature. Virtual infrastructures seem to promote the process of generating policy impacts, although it could also be a factor that these projects were generally shorter in duration than other types of project, and hence they would be able to realise policy impacts in the shorter duration of time.

6.2.3.3. Strength and variability of the key impacts

Increase in the priority given to RIs in research policies

There was evidence of projects having influenced R&D policies at regional, national, European and international levels. However, the effect on policy-making in domains beyond that of immediate focus for the projects was not relevant. The influence of different elements of the FP programme on national research policies is described in Figures 18 and 19 below.[22]

Figure 18: Increase in the priority given to RIs in national research policies by project scheme (%)

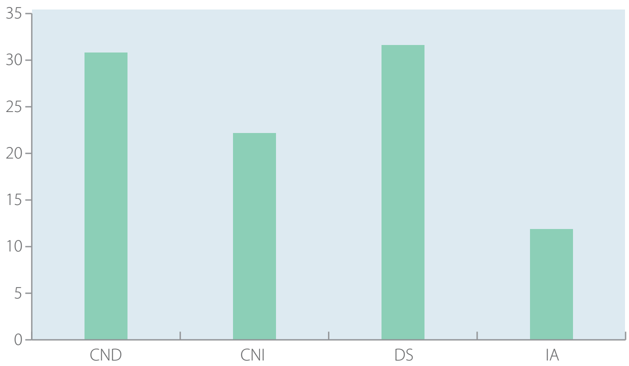
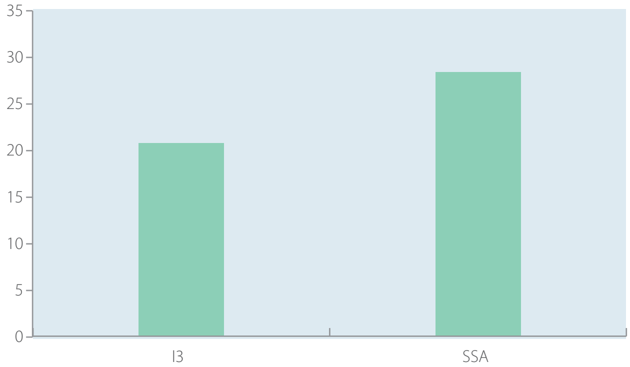


Figure 19: Increase in the priority given to RIs in national research policies by project instrument (%)



The results indicate that Design Studies and e-infrastructure projects were most successful in influencing national research policies. Overall, the SSAs were most likely to impact national research policies because these projects were funded with the specific objectives of coordinating approaches to RIs and needs analysis for future coordination and European action.

Examples of policy effects at national level included decisions by regional or national governments to invest in construction or upgrading of facilities as a result of the EC funding received for Design Studies or Construction of New Infrastructures. In addition, the involvement of NMS in projects encouraged national investment in RIs in these countries. Other examples of policy impacts beyond national level included protocols and standards generated during the FP6 project that had been adopted and implemented internationally.

The case studies suggested that one key driver of policy impact was the 'endorsement effect' achieved through the EU support itself in that it helped to raise the profile of the RI or the project either nationally or internationally. At national level, it often helped to generate interest among policy-makers and sometimes resulted in more funding. Internationally, the EU support often enabled the RIs to raise their profile in ESFRI-type discussions. Among the scientific community, EU support enabled RIs to take part in international scientific fora where they were able to influence developments and hence raise their profile.

22 The percentages reported here might be underestimates as a slight majority of case study projects reported having achieved this impact. The percentages shown in figures below are lower compared with the case studies.

At the same time, where RIs or projects struggled to benefit from this EU endorsement effect, it was often due to either a weak scientific user base, little buy-in from the relevant international scientific user communities, or weak links to the policy layers at national level and beyond. For instance, one Construction of New Infrastructures project failed to generate any users from outside its country due to the absence of a broader coalition with potential international user groups outside the country from the outset. A similar project is on the ESFRI roadmap, the difference being that the new project is backed by the relevant international scientific communities. Another Design Study of great strategic importance for Europe is not being able to generate sufficient support at policy level or among its user community due to lack of a direct link to policy-makers and due to an ageing user community.

CASE STUDY EXAMPLES: Impact on research policies

- The LASERLAB Europe (I3) project proved to be a successful collaboration in the field of laser-based research, showing that it is an area worthy of larger European investment. The project influenced the decision to place two very large and important European laser infrastructures on the ESFRI roadmap, thus further promoting the role of laser-based research in European research policy.

- The large Communication Network Development (I3) projects such as GEANT2, EGEE and DEISA show considerable impact on national research policy in terms of the investments made by National Research and Education Networks and the awareness of the importance of communication networks and high-performance computing to research today.

- The European Social Survey Infrastructure (ESSi) I3 project is a virtual infrastructure which supports multiple datasets on methods, standards and protocols relating to the European Social Survey, in order to improve the data collection methods and harmonisation of the pan-European social data. The data collection rounds are not part of this project (funded separately) but the ESSi has encouraged a stable funding structure over five years which has helped national funding bodies to give it their support. The European Social Survey is included in the ESFRI roadmap.

- The EUSAAR (I3) project is affecting European policies and regulation through the Convention on Long-Range Transboundary Air Pollution for which the EUSAAR site is the model of reference. A new EU directive published in 2007 that requests Member States to monitor pollutants outside urban areas is requiring specific monitoring protocols in which EUSAAR is actively involved.

Conclusions and overall assessment

There is evidence of impacts on RI policy at national level and beyond, demonstrating that the programme is achieving impacts beyond the quality and use of the RIs themselves. The association of impacts with projects which are closer to completion suggests that this impact would be stronger if measured in the future. Clearly, the programme's investment in ICT e-infrastructures has an impact on national policies in terms of priorities and this is somewhat less prominent for the other RI project types. There was no impact on policies outside the domain of RIs. This is perhaps not surprising in that the RIs very often cater for very specific user groups which themselves exert pressures on policy bottom-up in their areas of interest.

6.2.4 Impact on economy/industry

Just under a fifth (19 %) of all FP6 RI projects anticipated economic and industrial impacts at the start of the project. The results below indicate the type of impacts already achieved and describes the types of project for which industrial impacts were more likely.

6.2.4.1. Programme objectives and expectations of economic and industrial impacts

Expectations of economic and industrial impacts were not explicit in the programme objectives, nor were likely economic impact, industry needs or relevance part of the project selection. The reason for investigating economic impacts was that the programme represented a large public investment in RIs, and large RIs and communication networks have been shown to generate economic and industrial impacts in terms of contracts to industry, developing new instruments and, indirectly, allowing improved R&D by industry users of RIs. These impacts are notoriously difficult to measure, but can usually be identified. Movement of researchers from projects into industry was also examined, as this is an important indirect way in which research programmes achieve benefits for industry.

6.2.4.2. The predictors of economic and industrial impacts

The statistical analysis was not able to find strong predictors of economic and industrial impacts that relate to key aspects of FP6. Certain generic features were indicated such as the fact that a large number of participants within a project predicted less industry use of the RI. This is likely as industry actors are inclined to work within a smaller consortium of partners, given the related issues with IPRs and patents.

The 19% of projects that anticipated economic and industrial impacts at the start of the project were in general e-infrastructure projects and Design Studies. The results below show which economic and industrial impacts were achieved and the profile of projects that achieved them.

6.2.4.3. Strength and variability of the key impacts

Increase in the industry involvement

There was some evidence of projects having had an impact on relations with industry partners. The clearest effect was an increase in the industry use of the RI that was relevant for 13% of the projects overall. Figures 20 and 21 indicate the prominence of increased industry use of the RI across the schemes and research instruments.

Figure 20: Increase in the industry use of the RI by project scheme (%)

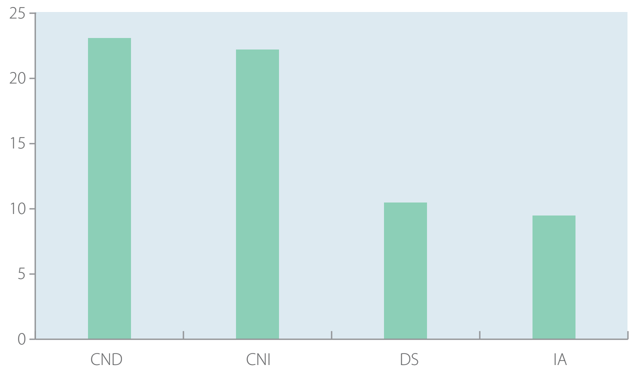
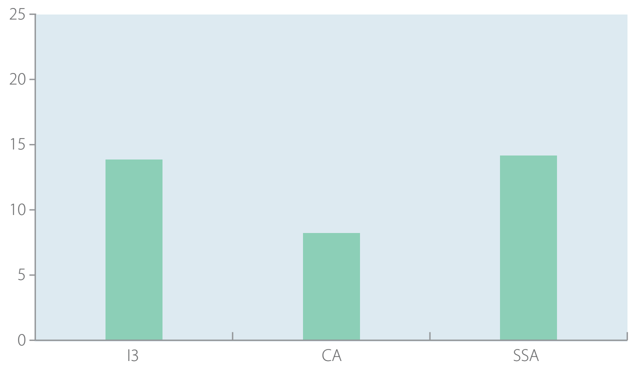


Figure 21: Increase in the industry use of the RI by project implementation instrument (%)



The results show that increases in the industry use were most marked within e-infrastructure (CND) and CNI projects, possibly because these projects would require industry involvement to be realised. It is possible that industry use of an RI was conflated with industry use of an RI in the minds of respondents. Interestingly, of the research instruments, this was most relevant for SSA and I3s. SSAs included design and construction projects.

However, changes in the level of industry participation in the area of science where the RI operated and joint projects with industry were not prominent. Joint projects with industry were realised within few projects but were expected to be realised by a majority of projects in the future. This was particularly relevant for the CNI and e-infrastructure (CND) projects. There was also some evidence of industry having benefited from the RIs, taking the form of RIs generating new business for suppliers and manufacturers of goods and services to the RI. There was also some evidence of project researchers in their RI or institution moving to industry.

CASE STUDY EXAMPLE: Outcome of industry involvement

The EGEE (I3) project has stimulated several start-up companies, taking advantage of the opportunities offered by the Grid. One example is a high tech start-up in Cambridge (UK) planning to use the open source grid in a product for image searching, another UK company offering commercial support services for grid services and a training company in Switzerland (training for grid services). All, however, remain small-scale operations.

Evidence of commercialisable outcomes

There was little evidence of projects having produced commercialisable outcomes. Some projects however had a commercialisation strategy and licensing agreements in place but they were the small minority overall. Commercialisation strategies were most relevant for Design Studies. A couple of projects had produced spin-off companies, created patents or established new industrial processes. These projects tended to be related to DS and CNI projects. Overall, there was little evidence for projects having directly or indirectly generated a regional economic impact or having achieved commercialisable economic outcomes to date.

CASE STUDY EXAMPLES: Commercialisable outcomes

- The VO-TECH project (Design Study of European Virtual Observatory) has attracted interest from Microsoft and Google in its database building and software development; thus, there is potential for longer-term economic impact, although with much uncertainty attached.

- As part of the DesignAct project, a spin-off company was established for the construction process, where local investors had been identified and included for the upcoming construction of the facility. The interviewees gave examples of dialogue with the national fish farming association, as well as investments made directly or indirectly by SIVA and Innovation Norway –government-owned organisations promoting industrial development in Norway.

Conclusions and overall assessment

The programme has not generated clear evidence of impacts on economy and industry except in a few cases, although there have been some benefits for suppliers and manufacturers of goods and services and some movement of researchers into industry. Nor was there a general rise in RI use from industry. Few projects had a commercialisation strategy, suggesting that impacts here in the medium to longer term are likely to remain very low.

6.2.5 Impact on wider society

19% of all FP6 RI projects anticipated impacts on the wider society at the start of the project, with about a quarter of these projects also expecting impacts on industry. The results below indicate the type of impacts already achieved and, where possible, describes the types of project for which societal impacts are more likely.

6.2.5.1. Programme objectives and expectations of impact in relation to the wider society

The programme had no objectives relating to impact on wider society, nor were there any project selection criteria in this domain; yet some of the projects did anticipate such benefits. Wider socio-economic impacts can be traced from research programmes, but typically take many years and many other factors to be realised. The reason for investigating this was that a large public investment relating to research and communication networks might be expected to have some impact (even if unexpected) on the wider society. Unless the projects had a societal component, impacts on the wider society would be expected to materialise only in the medium to long term and rather indirectly.

6.2.5.2. The predictors of wider societal impacts

Given the difficulty in measuring impact in this area, the following measures were used as a proxy to determine the extent to which projects were on a path to generate wider societal impacts. These were degree of liaison with local communities and non-commercial use of research resources.

The degree of maturation of projects was found to be associated with RI projects engaging with actors outside the immediate science community. This provides an indication of opening up to a wider audience. No specific FP6-related factors were found to be associated with wider societal impacts. The result is shown in Table 6 below.

Table 6: Description of factors associated with impact on wider society

Model parameters		
Impact on	Type of impact	Predictors
Dissemination to wider stakeholders	Liaison with local communities as a result of the FP6 project	Progress towards completion

Note: Each of the associations reported in the table were found to be statistically significant to the extent that there is only 5% probability that they occurred by chance.

In general, the types of project that anticipated wider societal impacts at the start of the project were e-infrastructure projects and those that were implemented as I3s. The results below show which wider societal impacts were achieved and the profile of projects that had achieved them to date.

6.2.5.3. Strength and variability of the key impacts

Dissemination of results to a range of stakeholders

Perceived definitions of societal impacts varied widely ranging from increased awareness and knowledge of a specific research area by the public to more positive perceptions of European collaboration in R&D among lay audiences.

70% of projects had a public dissemination strategy in place. However, only minority of projects had extended actual dissemination activities to local communities to date. Nevertheless, as has been seen, this is more likely when projects are closer to completion. Figures 22 and 23 below show the types of project that have already realised liaison with local communities.

Figure 22: Liaison with local communities already realised by project scheme (%)

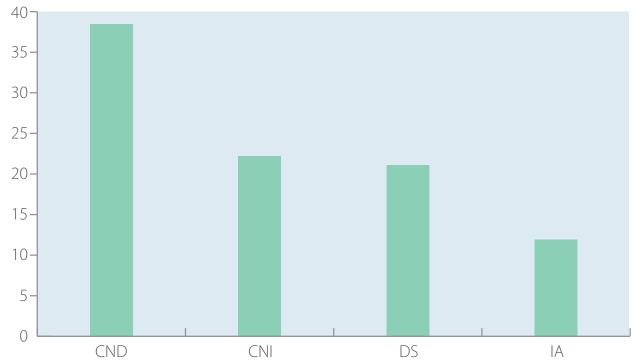
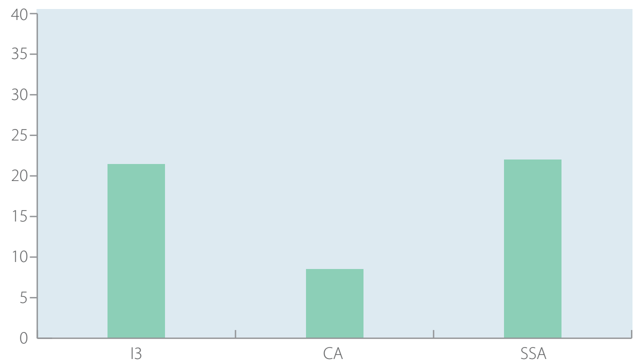


Figure 23: Liaison with local communities already realised by project implementation instrument (%)



The results show that e-infrastructure (CND) projects were most likely to have already realised in liaison with local communities. This probably indicates the links to the National Research and Education Networks who which liaise with their scientific communities. SSAs and I3s were equally likely to have already realised liaison with local communities. Here, there may have been some conflation of local communities more broadly defined with local scientific or user communities. However, many I3 projects are groups of large scientific facilities which may individually have local community liaison and outreach programmes through which the project was publicised.

CASE STUDY EXAMPLES: Public dissemination

- The IMECC (I3) project (Infrastructure for Measurement of the European Carbon Cycle) is playing a role in public awareness of carbon and carbon accounting.
- The 'Fascination of Light' exhibition, associated with the LASERLAB EUROPE (I3) project has been very positively received and helped promote basic science and, more specifically, laser technology to a wider European audience.
- The GeneExpress Design Study looked at the creation of a gene expression analysis centre for early human development. This project had to explore the ethical frameworks for such an infrastructure. The societal impacts expected if a facility is built are more public engagement in and acceptance of human embryo research for improved understanding of human development. However, these would take some time to be achieved.

The more concrete examples of wider societal impacts were very limited and tended to focus on medical advances, the environment and/or safety issues.

During the case studies, projects seemed to find it relatively easier to think of potential health and environmental benefits resulting from the project than other wider societal benefits, for example through potential research in these areas being facilitated by the project (such as better modelling of climate change being facilitated through access to e-infrastructures).

Evidence of use of research resources

There was strong evidence of projects having already realised the non-commercial use of research resources. 64% of the projects overall had done this and was particularly relevant to e-infrastructure (CND) and IA projects. There may be use of research results leading to societal benefits in the longer run. Few examples of this were found and one is outlined below.

CASE STUDY EXAMPLES: Direct and indirect societal impacts including non-commercial use of research resources

- The EURONS (I3) project had developed an imaging technology that could be used in the future for medical advances through its ability to localise cancer more accurately enabling faster diagnosis. The EURONS projects also contributed to detection methods for dangerous materials that have an application to 'Homeland security'.

- The int.eu.grid (I3) project has sought to work with users beyond the traditional High Energy Physics communities to promote access to interactive supercomputing. In Spain, partners have enabled several hospitals to actively use the grid for analyses of brain scans which have directly benefited patients. This is at present still classed as 'research' and is not yet part of normal clinical practice, but shows a potential path to a societal impact in terms of improved patient care and treatment.

- The int.eu.grid (I3) project also enabled an SME access to the e-grid which enabled it to produce more accurate models for a regional water utility company in Spain, thus helping it to manage its water supply more efficiently. This was expected to generate wider benefits through ensuring a more regular water supply in a region continuously fighting against water shortages.

- The IMECC (I3) project is playing a role on public awareness. CO2 measurements are required by the Kyoto Protocol and have a wide implication for studies on climate change. The data generated by the project are of use in the public arena.

- The Baltic grid (I3) project was able to show the Estonian government that the bandwidth of the National Research and Education Network broadband network was fully utilised and that there was a need for data transfers. This spurred the government to upgrade the bandwidth from 1 GB to 2.5 GB. This upgrade meant that users within the Estonian education and research networks got much better connectivity and networks.

- As a result of European collaboration in the IASFS (I3) project, researchers identified the structure of an important enzyme involved in the replication of the SARS virus.

Conclusions and overall assessment

There is evidence of possible future realisation of impacts on the wider society but there is little demonstration of actual impacts systematically being achieved beyond a few ad hoc examples as described above. A few projects have realised some liaison with local communities, which is important but ultimately not enough to ensure wider societal impacts from this type of investment.

6.3. EUROPEAN ADDED VALUE RESULTING FROM THE RESEARCH INFRASTRUCTURES PROGRAMME

There is clear evidence that the European support actions have added value. While few projects clearly stated that their project would not have been possible without EC financing, the large majority were of the view that the European funding enabled certain activities that would otherwise not have been possible.

Activities undertaken have been optimised

It was the view from a majority of the projects that only the Commission offered the unique mix of funding for RI improvements and design to answer the needs of the research community, which by nature is international. Without Commission funding, a majority of projects could only have been partially realised.

In the majority of projects, the EU support actions contributed to an increase in the degree to which researchers were networked, and led to improvements in the quality of research infrastructure services and in the quality of research data. In addition, for the majority of the projects, the support actions enabled an increase in the number of young researchers (below the age of 35) working in the area of the project and the number of people receiving training in the use of equipment rose. Moreover, as was indicated in the impact section of this report, the FP6 funding and project instruments were directly associated with achieving these impacts.

Improvements achieved at operational level

From the perspective of the RIs, EAV was associated with better coordinated R&D activities and more effective harmonisation in operations. There were a number of examples of specific achievements attributed to European funding at operational level that specifically included access to facilities and networking in particular. In some instances, EC funding allowed many small laboratories to have equal access to the highest standard testing facilities. Post-doctoral and young researchers also profited from European funding which allowed them to gain practical project experience at European level and work on a topic of high scientific and political relevance, which would not have been possible with only national funding.

CASE STUDY EXAMPLES: Improvements achieved at operational level

- The goal of the ALMA Enhancement (CNI) project was to develop a new receiver band for the ALMA telescope array in Chile. This required the involvement of a few specific European centres of expertise that at the time could only be brought together by European funding.
- Proteome Binders (CA) project gathered together 26 European and 2 US partners within the field of molecular binding and applications for human proteomes. One of the largest genome-scale projects in Europe, it worked to establish an RI in the form of a comprehensive resource of affinity reagents for the analysis of the human proteome. The project, completed in 2008, developed at least 30 new or improved standards and achieved a common standard for protocols so that a protocols database can be built for scientists. The EAV was seen in the pooling of resources, knowledge and expertise and through the coordinated systematic development of quality control, protocols and standards and establishing a database scheme for a central repository.
- An important achievement of ITS LEIF (I3) project was the creation of a multi-site infrastructure structuring the scientific community and involving other disciplines that benefited from improved scientific tools and better information and training support in the use of low energy ion beams. There was also a noticeable increase in capacity and excellence which would not have been possible to the same extent without the EC funding.
- The IMECC (I3) project brought together many small laboratories under the highest standard of access to measurement facilities. Providing equal access across European countries would not have been achieved without EC funding which is also a sustainable improvement in the infrastructures.
- While the European Space Agency, as an intergovernmental body, is now a counterpart of the NASA in the US, the European planetary research community has remained fragmented and nationally oriented. There was a need for more cooperation as demonstrated by the number of organisations that gather in the Euro-Planet (CA) network (about 100) and the success of the European Planetary Science Congress. EU funding has exerted a leverage effect, and has given momentum for the European planetary research community to structure itself.

Increased visibility and commitment to funding

The Commission funding increased the projects' visibility which helped to establish the research field at European level. This also improved the ability of the project partners to attract follow-on funding. In particular, this led national governments to invest resources internally. In general, the international collaboration fostered open attitudes and as a result new partners were included in some of the projects from countries where this would not have previously been possible.

Some projects emphasised that the longer the experience of the site, and the longer and more established the collaboration between partners, the higher the success of the project. Overall, even where EC funding represented a relatively low proportion of the project's budget, it generated more benefits than the relative proportion of the funding would have warranted. Although similar activities would have been undertaken in the absence of EC funding, the focus would have been different – i.e. less European.

CASE STUDY EXAMPLES: Increased visibility and commitment to funding

- EAV was generated through the Geant2 (I3) project. This is particularly true when examining the sustainability of the project without continued EC funding. The project would not be sustainable at pan-European level. Whereas the central core of the network is considered self-sustaining, the periphery would suffer significantly without continued funding.

- The EurocarbDB Design Study project was to set the basis for better and better integrated research in the field of glycomics at a European level and beyond. This required multilateral cooperation and intense research activities that would not have been possible to achieve without EU funding. This provided an opportunity to move forward in this field at European level.

- The DEISA communication network development (I3) project has deployed a distributed heterogeneous supercomputer infrastructure in Europe, bringing together national high-performance computing centres and adding a superstructure. It has influenced continued national-level investment in supercomputing and opened high-performance computing to research communities such as in the life sciences which are not traditional users of such facilities. The EU project represents only seed money compared with the level of investments made nationally for high-performance computing, but it has created a European infrastructure of greatly increased scope and scale to offer European scientists opportunities for significantly improved research.

Impact of different funding levels and future considerations

The study found that variation in EC funding levels across the different types of project was rarely associated with the effectiveness of the FP6 projects. This indicates that in general EC funding invested in projects generated impacts as have been shown throughout this report. However, a number of findings about the relative efficiency of FP6 projects were found through statistical economic assessment about the specific impact of EC funding. The main findings indicated that:

- EC funding directed to SSA and CA projects produced a greater effect on industry participation than funding in I3 projects.

- EC funding of I3s directed to IA projects produced a greater effect on the number of young researchers working in partner institutions in the area of the project than funding directed to e-infrastructure projects.

- EC funding of I3s directed to IA projects produced a greater effect on the number of people receiving training in the use of equipment than funding directed to e-infrastructure projects.

These findings reveal insights regarding the distribution of the EC funding. To the extent to which EC decision-makers are interested in increasing industry participation, they should fund SSA and CA projects rather than I3 projects. However, the extent of industry involvement was small. To the extent to which EC decision-makers are interested in funding projects to boost the number of young researchers working in partner organisations in the project area or the number of people receiving training in the use of equipment, they should fund Integrating Activity projects rather than e-infrastructure projects. However, this is self-explanatory as the e-infrastructures projects have objectives concerned with creating networks, grids and high-performance computing for which the above outcomes are less relevant.

Conclusions and overall assessment

EC funding has increased the visibility of participants and generated operational as well as wider EAV in supporting activities that would otherwise not have been possible at European or international level.

To the extent to which EC wants to attract or increase industry participation, funding should be targeted at SSA and CA projects rather than I3 projects. However, to the extent to which increasing the number of young researchers or the numbers of people receiving training in the use of equipment is considered important, the Commission should fund Integrating Activity projects rather than e-infrastructure projects.

7. Recommendations

7.1. Improving pertinence

- Future programmes should strive to include all relevant partners from Member States. Additional focus should be placed on including relevantly qualified groups from NMS. This is likely to improve the scientific quality and impact on the RIs and further put projects in a better position to influence policy and gain longer-term sustainability.

- More effort should be made for projects to include new user communities in areas of research outside the traditional user groups. This will promote interdisciplinary approaches and enable researchers to be trained across disciplines. Overall, the Commission should continue to encourage transnational access to RIs in order to broaden nationally driven operations.

- All types of Commission-led support action should encourage the involvement of existing and potential users. This will ensure that there is support for the initiative within the communities and that it meets their needs.

- Future programmes should more explicitly take into account areas of strategic importance to the ERA internationally whilst encouraging bottom-up applications for funding. This is to ensure that there is an adequate balance between demand-driven, bottom-up advocacy by strong user communities and areas of strategic importance for which there is a need for investment.

- Within non-e-infrastructures projects, greater emphasis should be placed on incorporating e-infrastructure elements. This could be achieved by funding hybrid projects that enable remote access to users and support virtual data archives. By the same token, e-infrastructures projects should be encouraged to widen their user base and cater for more types of user.

7.2. Strengthening impact

- On the basis of the study findings, it is possible for the first time to see what kinds of impacts different support actions under FP6 have been able generate. Looking forward, there is a need to recognise the areas where impacts have and have not been made and to adjust programme objectives and funding agreements to reflect this and to maximise EAV.

- The impact of RI projects on European and national policy could be strengthened through early engagement with policy-makers to attain a strategic buy-in from the start, rather than relying on this occurring as a result of the project. Often the financed projects are of relevance to driving R&D development forward in Europe, both nationally and internationally. There is potential for engaging national funding agencies with a strategic commitment to funding whose role is to disseminate the importance of investment in RIs to national policy-makers.

- The impact of the scheme on policies beyond the area of the RI could be maximised by emphasising the need for broader, applied science projects with a multidisciplinary focus. This would also open the opportunity for further cross-fertilisation between disciplines.

- The objectives of the FP6 programme did not explicitly state the expectation for projects to generate societal, economic and industrial outcomes. If these are to be fully realised, there should be a specific focus on including industrial partners in projects driven by generating IPRs and patents. In the future the Commission could support a small selection of projects with a focus on industrial technologies from which the expectation is that they generate societal and economic benefits.

7.3. Enhancing European Added Value

- The Commission needs to think carefully about the areas where it can add most value. The paramount importance of networking enabled by EC funding has been strongly emphasised in this evaluation. Equally it has been shown that networking in combination with joint research activities and transnational access has been a powerful tool to enable the materialisation of a wide variety of impacts. To reinforce EAV, the Commission should invest in activities similar to I3s that capitalise on the effect of networking within a wide consortium of partners as part of a mix of joined-up activities.

7.4. Enabling further structuring

- The inclusion of NMS into projects has been a success. Within the objectives of the ERA, this should be fostered further. NMS participation in projects should be promoted and their visibility increased. It is known that this visibility encourages national investment in research in the NMS. In light of this finding, it is also recommended that deeper collaboration is extended to candidate countries as this is likely to strengthen the ERA and research capabilities of these countries.

- It seems clear that the existing programme in FP7 and beyond will meet challenges in continuing the European networking, coordination and joint research and design activities. National research funding agencies will need to be persuaded that a higher degree of national support to multinational activities related to RIs in Europe and beyond, are in fact beneficial for their own facilities and researchers. This may be best realised by encouraging European governments to invest in international facilities, such as is demonstrated by the development of 'Facility for Antiproton and Ion Research (FAIR)' at the GSI, in Darmstadt Germany, but also to highlight the cost-benefit of facilitating access of national researchers to facilities abroad through national means, not just via Commission funding.

7.5. Development of impact measurement

- It is recommended that concrete impact measures based on the sound evaluation of existing and potential data sources are developed. This includes establishing a set of indicators (data measures) for which comparable time-series data can be collected. This will provide more specific and measurable impacts moving away from opinion-based indicators. This will enable impacts to be measured and evaluated more accurately in the future.
- It is recommended that evidence is collected which is in part differentiated between the e-infrastructure and the RI projects, in order to understand better the specificities of each area of the programme.
- It is recommended that research consortia are encouraged to think about their wider relevance to society, industry and European policy-making. This is required for longer-term impacts to be generated rather than them remaining as distant possibilities. This could be undertaken during project planning and further encouraged via specific support actions.

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Evaluation of pertinence and impact
Synthesis report

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The European Commission, through the Directorate-General for Research and Directorate-General for Information Society and Media, commissioned a study to evaluate and assess the impact of the Research Infrastructures related actions under the Sixth Framework Programme for Research 2002-2006. The study covers all modes of EU support actions to research infrastructures – Integrating Activities, Design and Construction of new infrastructures, e-infrastructures - except for Transnational Access projects.

The study shows strong evidence of impact of the EU actions on the standing of research infrastructures and on science communities. It analyses how the European added value and structuring effect of the research infrastructures programme contribute to reinforce the European Research Area. While impact on economy/industry is apparent in isolated cases, impact on wider society was not measurable in absence of appropriate indicators. The study also demonstrates that EU funded projects influenced research policy at regional, national, European and international levels.

More information on the Community research infrastructures policy can be found at:
http://ec.europa.eu/research/infrastructures

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