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Abstract:

This deliverable summarises the results reached through the application of ERINA+ assessment methodology. It identifies in an aggregated manner the point of strengths and weaknesses of the analysed projects in terms of socio-economic impact. The assessment has been executed using a qualitative-quantitative approach through the following blocks:

- e-Infrastructures and e-Infrastructures projects mapping;
- e-Infrastructures assessment through stakeholders' perception;
- e-Infrastructures impact and projects performance;
- e-Infrastructures impact on ERA.

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EXECUTIVE SUMMARY

ERINA+ project team developed an impact assessment methodology for the e-Infrastructures projects and the e-Infrastructures as a whole along the two concepts of efficiency and effectiveness where the first describes is measured through the Economic Net Present Value of the benefits generated by the technological advances brought by the project on the users' activities and the second is capability of producing an effect in terms of competitiveness and excellence of research, innovativeness of research and transfer outside the domain; cohesion.

The analysis carried out for exploring these dimensions where:

- e-Infrastructures and e-Infrastructures projects mapping
- e-Infrastructures and e-Infrastructures projects assessment through stakeholders' perception analysis (SPA)
- e-Infrastructures projects performance
- e-Infrastructures and e-Infrastructure projects impact on ERA

The e-Infrastructures and e-Infrastructures projects mapping was useful to identify the boundaries of the assessment exercise.

The stakeholders' perception analysis supports the overall assessment by using a semi-quantitative approach to gather the opinion of three groups of stakeholders in the e-Infrastructure domain, namely users, projects and key stakeholders. All groups have been addressed to share their assessment on questions related to indicators rather than asking them to follow predefined lines of directions in answering questions. The answers show a high appreciation on the effectiveness of e-Infrastructures. Users perceive to be more competitive as e-Infrastructures e.g. enable them to achieve faster results. The support of cross border collaboration is equally well perceived by users in enhancing cohesional impact of e-Infrastructures. This also holds for key stakeholders, especially on innovation issues. The results show, that projects do perceive the impact of e-infrastructures on innovation and cohesion not as strong as other groups of stakeholders. They do, however, increase their users competitiveness. Economic and cultural barriers are not seen as lowering the impact of the e-Infrastructures at a significant level. Governance bodies are suggested to collaborate based on their individual strengths to increase the long term impact of projects in the e-Infrastructure domain. At a legal level issues like data protection and ethics (including data privacy) are seen as crucial in a user-driven infrastructure development and need to be given further attention.

The analysis of projects in terms of efficiency show results that are in line with SPA one projects value returns to the economy a net benefit. In fact, if we if we consider the investments done (i.e. the costs), the projects - considered as a whole - return economic benefits three times higher. However, the analysis shows that there is a significant difference between minimum and maximum values of the projects and a high value of the standard deviation. In general, medium sized projects (from 2 to 5 million budget) better performs than the others with respect to offered and perceived efficiency. Similarly medium sized project in terms of users (between 100 and 1000) show a better performance. Big projects (in terms of budget and users) seem to be sustainable while the others necessarily need to be funded by the European Commission and/or to investigate about new business models.

Regarding the project's impacts in terms of effectiveness, results are encouraging and it is clear that the community under analysis is putting a considerable effort to disseminate the results of their project to the scientific community and beyond.

The average values obtained by the projects on their competitiveness of research show that they did not publish a very high number of scientific outputs, especially if considering articles with impact factor (average value 3,4). However, we must recognise that the e-Infrastructures projects we collaborated with stressed in more than one occasion their role in the scientific domain as facilitators of research activities more than as direct protagonist of the research itself. In other words, e-Infrastructures projects develop instruments that enable research but are not necessarily directly devoted to research activities. Moreover, most of the projects were still running in progress at the time of the assessment and papers are published normally in the last part of project life-time or even after end of the project. For this reason, it is interesting to see the results of the projects users, even if the sample is limited and the data need to be considered as partial.

Considering the total number of users, we can see that - thanks to projects outputs – they succeeded in developing 11 patents or patented applications. The number of IPRs produced is equal to 55, while the respondents acknowledged they created 33 spin-offs or start-ups. In terms of scientific production, we explicitly asked to map articles which contents would not have been possible to develop without the use of the specific project scenario/service in question. E-Infrastructures projects' users delivered 7 articles with impact factor, 68 peer reviewed articles without an Impact Factor and 76 non-peer reviewed papers/articles.

Projects did not develop Patents or patent applications, but delivered 124 IPRs, with an average value of 6.5 IPRs per project. From the phone interviews performed, we can say that the value is probably under estimated because for some projects it was difficult to count the exact number of IPRs and they did not have a database with all the outputs produced by the project and countable as IPRs.

Finally, the projects analysed developed 6 spin-off/start-ups: this result is very interesting because it is a signal of a possible link between the e-Infrastructures domain and the market.

Regarding the projects' impact in terms of innovativeness and transfer outside the domain, the assessment shows that the attention for training is quite high. Collaborating projects developed 484 training materials, 94 knowledge repositories or instruments fostering collaboration and knowledge exchange for users, 144 training events for a total number of 2,250 trained persons. This is an important aspect to ensure a positive impact of the e-Infrastructures in the future, as training is fundamental in order to allow a higher number of researchers to use them and as their complexity is often an important barrier.

Dissemination is another important element of the projects' activities. Projects organised an average of 2.1 events each, addressing an audience different from the e-Infrastructure one. Besides conferences, workshops and other events, projects also established formal agreements with actors outside the e-Infrastructures domain: 41 agreements in total, with an average value of 2.3 agreements per project.

Collaborating projects organized 355 dissemination activities, reaching a total audience of approximately 327.300 persons. The scientific community is the most relevant primary audience, while users represent the most important secondary audience. Only a limited number of dissemination events have been addressed industrial actors, students, civil society and policy makers.

Finally, the assessment highlighted a positive potential impact in terms of cohesion. e-Infrastructures projects connect partners from all around the world and the projects analysed developed 51 agreements with actors outside the EU. In the same way, even if a large majority of the dissemination events organized had an audience at European level, almost one fourth of the events reached an audience outside Europe. With reference to data related to woman and young researchers employed in the projects under analysis, we need to stress the difficulties that projects encountered in gathering this information, so that the results should be considered as partial. Having said that we can say that women represent a minority in the e-Infrastructures domain reflecting the well-known situation of woman in science.

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1 INTRODUCTION

1.1 General Context and Background

This report derives from the implementation of the methodology developed in the context of ERINA+ project (D.3.4 and/or D3.5). The methodology is aimed at assessing the socio-economic impacts of the e-Infrastructure projects and the e-Infrastructures ecosystem according to the available data.
The purpose of the e-Infrastructures' impact assessment exercise is threefold:

1. to help cultivate an ecosystem and assessment mentality: to identify what is the impact of any given project, program and investment in the context surrounding the e-Infrastructures ecosystem.
2. to demonstrate that through the impact assessment online tools which were created from the methodology that we begin to understand how to amplify to amplify the benefits of each single initiative at the widest possible level.
3. to help EC decision makers to understand how to optimize the use of resources invested in e-Infrastructure.

With the above mentioned objectives, the ERINA+ project has designed a methodology that explores the different dimensions of e-Infrastructures ecosystems and assesses the additional value produced by the e-Infrastructures projects and initiatives, as well as the benefits that e-Infrastructures bring to the general economy and social welfare.

1.2 Scope and Target Audience

This deliverable describes the findings of the ERINA+ team that derive from the deployment of the methodological framework and online tools for socio-economic impact assessment of e-Infrastructures and e-Infrastructure projects described in D3.5. The assessment exercise is based on the data:

- provided by 20 e-Infrastructure projects through the ERINA+ Project Self-Assessment Webtool;
- collected through the Users Data Gathering Interface;
- collected through the Stakeholders Data Gathering Interface;
- provided by the European Commission;
- collected through the mapping exercise performed by the ERINA+ team.

Since the deliverable is of public nature the analysis performed in chapters 4 and 5 is presented at an aggregated level in order to meet the requirements of the Memorandum of Understanding signed with e-Infrastructure projects that ensure the confidentiality of projects data. The deliverable is structured in order to be a standalone document however the main target group of the deliverable remains professional evaluators, i.e. ERINA+ team, collaborating projects' (internal) evaluators and socio-economic experts in general and the European Commission. The restriction of the audience to experts is mainly suggested because of the level of detail and the language used in this document. However, the methodology and the glossary available within D3.5 may facilitate the reading of the document.

The results also constitute the starting point for the considerations contained in D6.2 Research Policy Recommendations – White Paper.

1.3 Structure of the Document

After the introduction, the document is structured into five chapters.

In particular:

- Chapter 2 provides an overview on the ERINA+ methodology and tools.

- Chapter 3 describes the results of the Stakeholders Perception Analysis
- Chapter 4 summarises the results in terms of efficiency and effectiveness coming from the self-assessment exercise (Project Self-Assessment Webtool) carried out by e-Infrastructure projects
- Chapter 5 provides a high-level overview of the impact of e-Infrastructures on the European Research Area though the use of social network analysis and business intelligence tools applied to data coming from e-Infrastructures projects, projects Users, as well as from the European Commission .

1.4 Acronyms

Acronym	Explanation
B/C	Benefits/Costs
e-IRG	e-Infrastructure Reflection Group
ENPV	Economic Net Present Value
ERA	European Research Area
ESFRI	European Strategy Forum on Research Infrastructures
FP	Framework Programme
ICT	Information and Communication Technologies
RI	Research Infrastructures
RTD	Research Technology & Development
S-E	Socio-Economic
SIA	Social Impact Assessment
SNA	Social Network Analysis
SPA	Stakeholder Perception Analysis
VRC	Virtual Research Communities
WtP	Willingness to Pay

2 EVALUATION METHODOLOGY AND TOOLS

2.1 Introduction

Most of the ability of Europe's research teams to remain at the forefront of all fields of science and technology relies on the support that they receive by state-of-the-art research infrastructures.

A research infrastructure is defined as the set of facilities and resources, either "single-sited" or "distributed" that provide essential services to the research community in both academic and/or industrial domains.

With the final aim to optimise the use and development of the best research infrastructures existing in Europe, the EU 7th Framework Programme (FP) gives its support for the development of new research infrastructures (also at the regional and cross-regional level), and for the operation and enhancement of existing infrastructures.

Under FP7, e-Infrastructures' activity is part of the Research Infrastructures programme, funded under the FP7 'Capacities' Specific Programme. It focuses on the further development and evolution of the high-capacity and high-performance communication network (GÉANT), distributed computing infrastructures (grids and clouds), supercomputer infrastructures, simulation software, scientific data infrastructures, e-Science services, as well as on the adoption of e-Infrastructures by user communities.

Within FP7 91 projects in the e-Infrastructure domain (both Collaborative Projects and Coordination & Support Actions) have been financed within 5 calls (call 1, 2, 4, 5 and 7) since 2009 (160 projects if we consider FP6).

Among these, the ERINA+ project was funded in order to understand and measure the socio-economic impact of e-Infrastructure projects, the e-Infrastructures themselves as part of the European Research Area (ERA) and on the society at large. The need of a socio-economic impact assessment of e-Infrastructure activities is generated from a European Commission (EC) research policy shift which, from an emphasis in the early Framework Programmes on funding research that is "far from the market", is leading to an increasing emphasis on the assessment and maximisation of socio-economic impact and exploitation of research results [9].

In this framework, we developed and tested a quali-quantitative assessment methodology and a set of software tools aimed at providing a realistic understanding of the impact of e-Infrastructures and to spread the culture of impact assessment among the research communities.

2.2 Issues affecting the e-Infrastructures assessment and ERINA+ objectives

The development of the ERINA+ approach to assess e-Infrastructures is based on a careful analysis of the key issues affecting impact evaluation in such a domain, as well as on the interaction with different categories of stakeholders, such as project coordinators, users, program managers and policy makers.

It is widely accepted that determining the impacts of research advances is not a straightforward task and that it is a big challenge to find reliable and valid metrics for the large variety of complexly interconnected, indirect, diffuse, non-tangible and delayed impacts produced by research and the research infrastructures [11].

The existing literature shows that presently we cannot rely on a well-developed model that explains the complex relationships between e-Infrastructures and projects in the e-Infrastructure domain and their impact on society.

e-Infrastructures are a complex ecosystem involving the co-evolution of technology and research where change in anyone element represents a change in the ecosystem, and any deterioration is a threat that works at different stages. So, it is important to see the cyberinfrastructures as a coherent ecosystem from the laboratory level to the campus level, from the national level to the global level, considering that e-Infrastructures have emerging properties that are somehow unpredictable, for example, the multiple sources of control. Thus, the first issue is to identify to which extent a particular piece of work influences a specific scientific result.

The time-lag between research completion and its potential impact is another critical factor. Impact assessments may not be able to identify impacts if research messages have not yet filtered through. The timing is often inconsistent with the expectations and needs of policy makers for evaluation [5].

We also need to understand that impacts may vary widely across disciplines and sectors. The extent and nature of research influences on economy, policy and social dynamics depend, however, not only on the actual research findings, but also on the ways in which these findings are delivered and the environment into which they are delivered [14]. Processes (user engagement, dissemination, networks, consultancies etc.) and context (e.g., policy relevance, user receptiveness, timing, financial or political issues) will all have a bearing on the uptake of research findings.

Moreover, despite a number of well-accepted definitions of e-Infrastructures, we need to find an approach that is able to capture the complexity of the relations among different projects, initiatives and domains that must be explored in order to carry out the assessment. The issue also relies in defining the geographical and time boundaries of e-Infrastructures ecosystem evolution. In line with Allee [1], we can apply to the e-Infrastructures the characteristic of "value network" that is "any web of relationships that generates both tangible and intangible value through complex dynamic exchanges between two or more individuals, groups or organizations".

Concerning the evaluation approaches, in the economic literature we can distinguish between general studies focusing on the relation between growth, competitiveness, and science and technology; and studies aimed at better understanding such relationship with reference to a particular infrastructure [18]. In the latter, we can distinguish impact assessment studies aiming at identifying expected impacts (ex-ante studies) and studies that measure and evaluate real impact after the end of a project or programme (on-going or ex-post studies). Considering the usual approach being Input→Output→Outcomes→Impact [20], for the research infrastructures the outcome and impact indicators are the social and economic objectives intended through the intervention and occurred after the outputs interact with society and the economy. So, the main objectives of research e-Infrastructures assessment exercise include the evaluation of the:

- Improvement of R&D efficiency and the scientific and technological knowledge base.
- Enhancement of economic performance and productivity growth.
- Improvement of the quality of human resources.
- Promotion of social cohesion.
- Facilitation of scientific knowledge and technological diffusion.
- Generation of employment.
- Reduction of transaction costs.
- Improvement of quality of life.

2.3 The ERINA+ Methodology

With these above mentioned assumptions, we are aware of the difficulties that arise from the ambition of identifying a sound, useful and efficient standard methodological framework for assessing the impacts of all the existing European funded e-Infrastructures and projects.

The Impact Value Chain as a measure of change is addressed as follows:

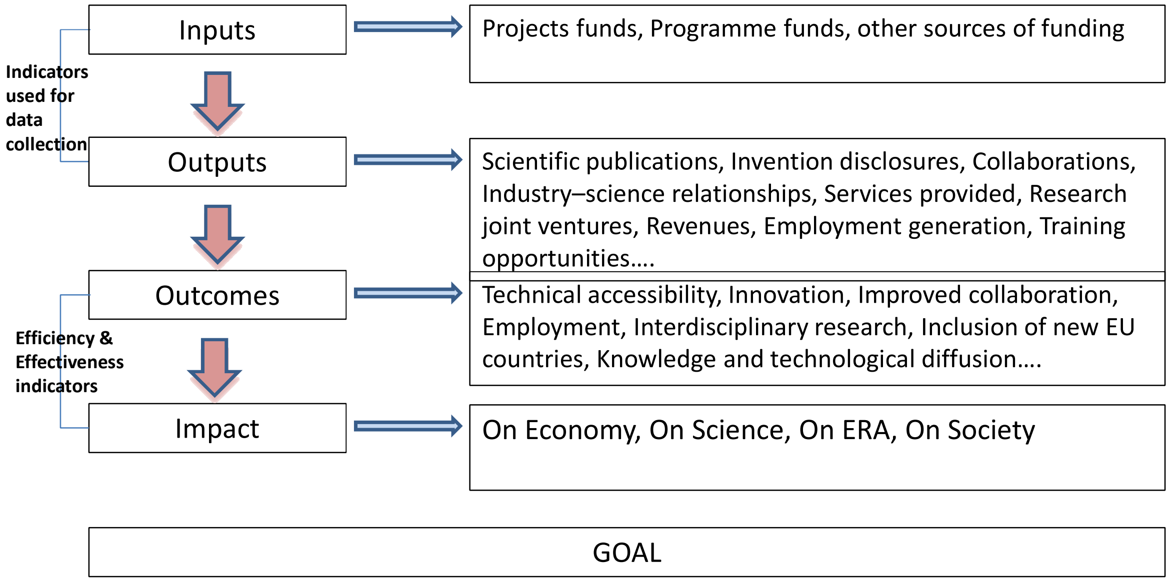


Figure 1: e-Infrastructures Impact Value Chain

According to the literature review the ERINA+ impact assessment approach is developed along the two concepts of efficiency and effectiveness [6]:

- **Efficiency** describes the extent to which time or effort is well used for the intended task or purpose. In general, efficiency is a measureable concept, quantitatively determined by the ratio of output to maximal possible input. In the ERINA+ methodology, the efficiency of the e-Infrastructures is measured through the Economic Net Present Value of the benefits generated by the technological advances brought by the project on the users' activities;
- **Effectiveness** means the capability of producing an effect, and is most frequently used in connection with the degree to which something is capable of producing a specific, desired effect. Effectiveness is, generally speaking, a non-quantitative concept, mainly concerned with achieving objectives.
  Therefore, the ERINA+ methodology identifies, within such category of impact, 3 different sub-areas, in relation to as many identified objectives for the e-Infrastructures domain:
  - *competitiveness and excellence of research*: the impact that the e-Infrastructures and the e-Infrastructures projects have on the capacity of the European researchers (and other general users) to produce their scientific output, in order to compete with the other Countries outside the EU and to produce high quality work published over a sustained period of time, to gain a reputation as excellent researchers in their field and to demonstrate research leadership at least within their own domain (School/University/research centre).
  - *Innovativeness of research and transfer outside the domain*: measures the impact that the e-Infrastructures and the e-Infrastructures projects have on the capacity of transferring the knowledge produced from the specific research domain to a wider public (e.g. industry and society).
  - *Cohesion*: measures the impact that the e-Infrastructures and the e-Infrastructures projects have on the capacity of stimulating the networking between researchers of

the EU old member States, new member States and actors behind EU boundaries. Besides, it measure the capability of e-Infrastructures project to engage woman in science and, more generally, to be socially inclusive.

As evident, assessing the impacts of e-Infrastructures and e-Infrastructures projects is a very difficult task, and it requires the consultation of different data sources, the use of different tools for data collection and a comprehensive analysis and synthesis of heterogeneous information, using mixed techniques, both qualitative and quantitative [18].
To face these problems, the ERINA+ consortium proposes a 4-blocks assessment process, conceived as following:

1. Each block provides some information both for the general assessment of e-Infrastructures and e-Infrastructures projects, both for the implementation of the actions of other blocks: in other words, each block either is stand alone, and provides upwards and downwards feedback to others as well.
2. Each block gives a different contribution in assessing each category of impacts.

In particular, the ERINA+ assessment approach is articulated into the following 4 blocks:
Block 1: e-Infrastructures and e-Infrastructures projects mapping
Block 2: e-Infrastructures and e-Infrastructures projects assessment through stakeholders' perception analysis
Block 3: e-Infrastructures projects performance
Block 4: e-Infrastructures and e-Infrastructure projects impact on ERA

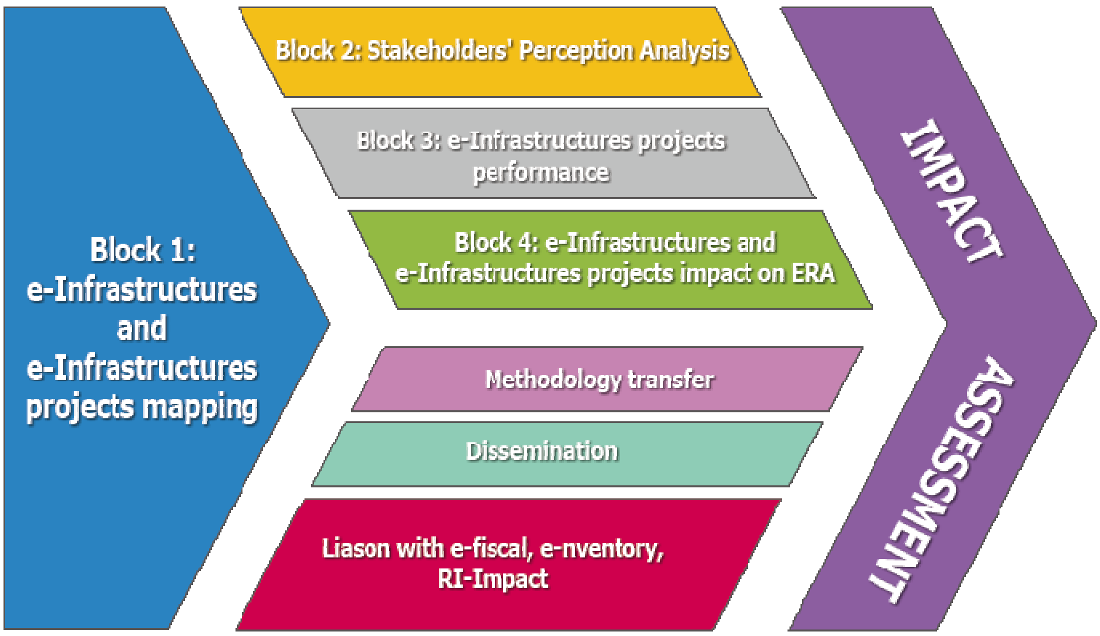


Figure 2: ERINA+ value chain

The set of evaluation approaches reviewed for the development of the ERINA+ methodology is composed by recognised techniques orientated to the assessment of the socio-economic impact of RTD policies. Each of the evaluation methodologies presented has its own strengths and limitations, and the ERINA+ consortium has selected them according to the particular requirements of the e-Infrastructures.
The following paragraph provides an overview of the instruments that were developed in order to make the assessment methodology operational and sustainable beyond the ERINA+ project termination. Indeed, the Platform has been developed by using open source technologies.

2.4 The ERINA+ Web Platform

The ERINA+ Platform transforms the above described methodology into a set of integrated software tools for the e-Infrastructures (and related projects) monitoring and assessment.

The Platform interacts and provides feedback to the different typologies of ERINA+ project users:

- the project managers (project coordinators or the people that have the responsibility of the projects and they need to integrate and evaluate the work in progress and the evolution of a specific project);
- the programme managers (people that have interest in the evaluation of the quality of the investment into the e-Infrastructure domain. They include also the EC members that want to have the perception of the returns in function of the improvement of the e-Infrastructure domain);
- the stakeholders (people that have interest in the evaluation of the quality of the investment into the e-Infrastructure domain. They include also the e-Infrastructure users and the EC members that want to have the perception of the returns in function of the improvement of the e-Infrastructures domain).

Through the Platform they can provide useful information for the assessment and they can visualise the main ERINA+ indicators on the e-Infrastructures Platform, in particular, is composed of the:

- Project Self-Assessment Webtool.
- Users Data Gathering Interface.
- Stakeholders Data Gathering Interface.
- EU Data Visualisation Dashboard.
- ERINA+ Database (DB)

The main features of the Platform is its dynamicity since the higher is the number of projects and e-Infrastructure stakeholders that use the Platform, the better is the quality of the information processed and returned for projects' and e-Infrastructures assessment.

The main components of the Platform are described in Figure 3 together with the informative flows among them.

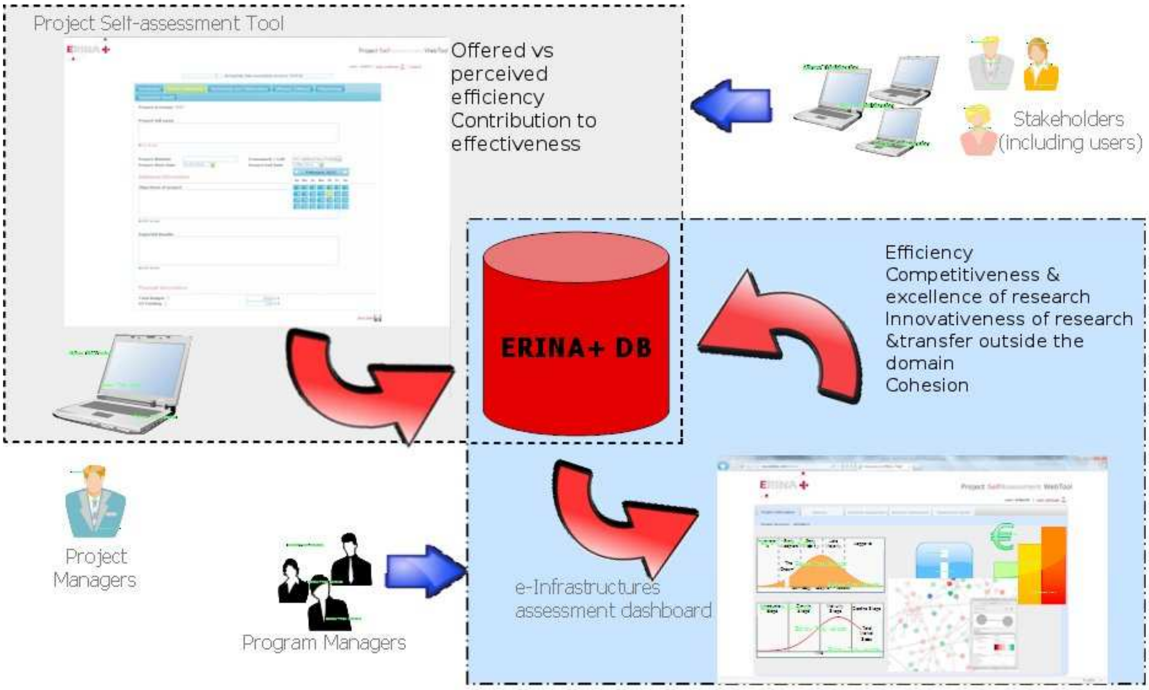


Figure 3: ERINA+ Platform

Through the Project Self-Assessment Tool data is fed into the ERINA+ DB and then it is integrated with other data provided by the other open data sources.

The Platform has been developed using open source technologies in order to facilitate further improvements.

2.4.1 The Project Self-Assessment Webtool

The aim of the project self-assessment tool is to provide a facility for the project manager, in order to understand the sustainability and impact that his/her project has on the e-Infrastructures domain and on the society at large. To this end, the tool combines the data collected from the project with the data inserted by the users, as described above.

Each project, by simply logging to the ERINA+ Platform and Webtool, finds:

1. A list of questions to be answered in order to assess projects' impacts in terms of performance “offered” to the users: some information has to be provided by the projects themselves (e.g. layer typology, technological advances brought by the project etc.), while other is prefilled by the ERINA+ staff, thanks to the information gathered during Block 1, being the projects mapping.

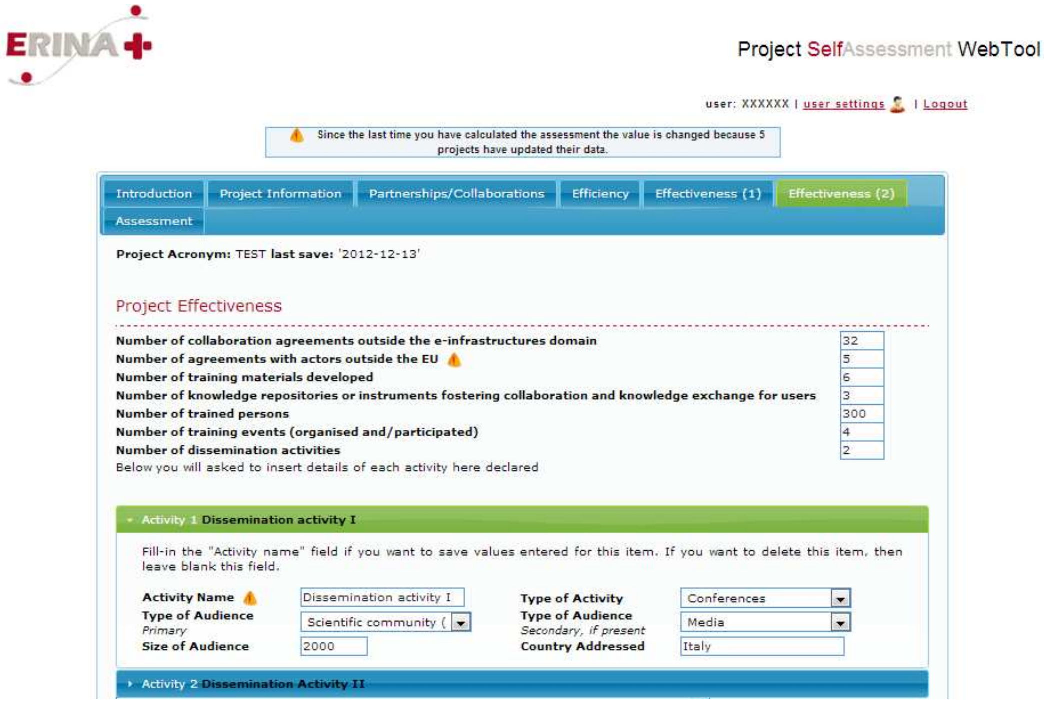


Figure 4: Data gathering interface

2. The Platform database is populated with the information deriving from the Users Data Gathering Interface where information about the projects "perceived" performance (e.g. number of papers published thanks to the use of the service, savings in working hours, etc.) is collected.

3. These two sets of information are crossed and processed in order to provide a fast assessment feedback on project performance.

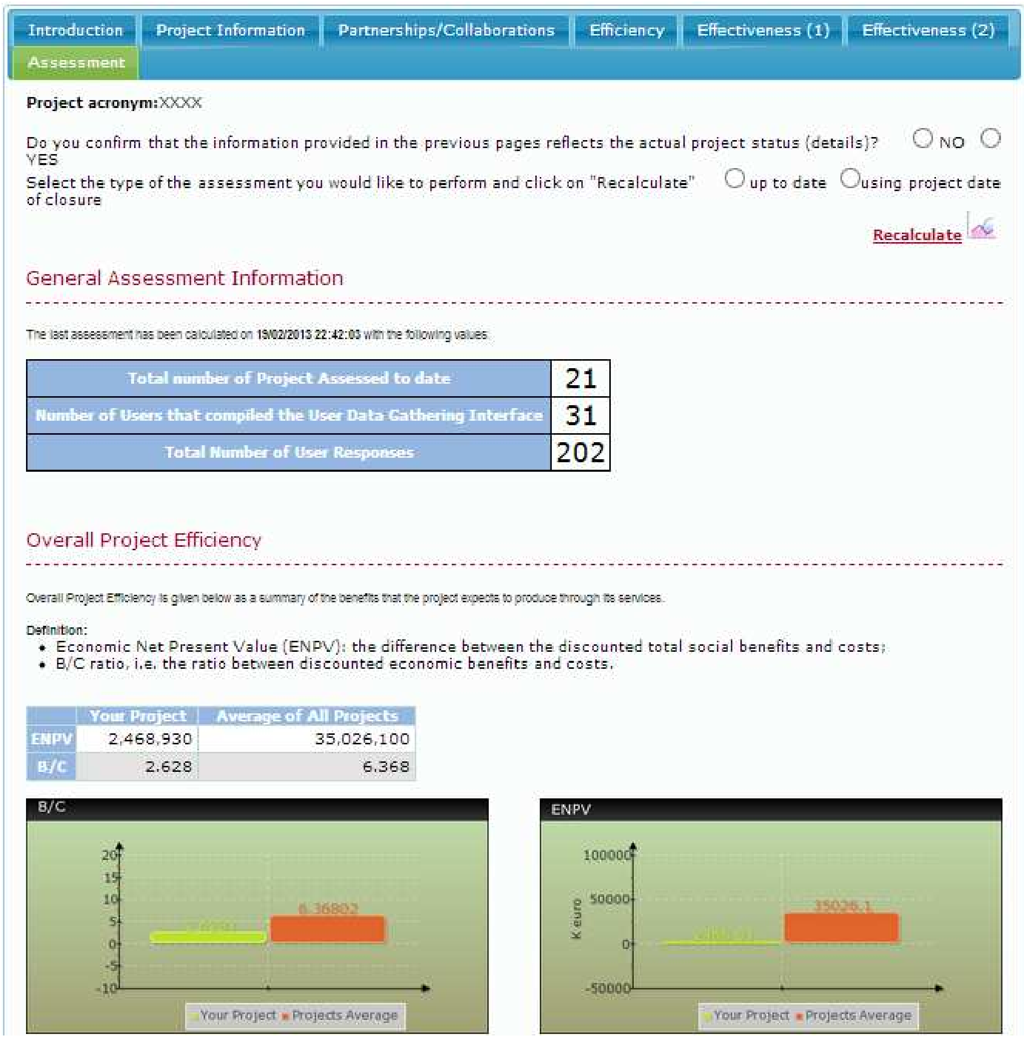


Figure 5: ERINA+ project assessment

2.4.2 EU Data Visualisation Dashboard

The ERINA+ Dashboard works as a visual interface of the content stored in the ERINA+ database, including the information coming from the network analysis.

This activity deploys the knowledge base created from the different ERINA+ methodology blocks, in order to set up a "business intelligence" system, able to monitor and evaluate at the aggregate level the evolution of the e- Infrastructures through the use of statistical and qualitative tools.

The aggregated analysis provides the information about:

- Net present value
- Info about users
- Publications
- Intellectual Property Rights (IPR)
- Employment and gender mainstreaming
- Spin-offs and start-ups
- The impact on ERA
- Stakeholder Perception Analysis
- Collaborations and social capital

The outputs of block 4, the graphs and indexes generated by the use of Social Network Analysis are also included in the ERINA+ Dashboard.

The graphs are shown in two ways: static and dynamic. The user is able to select the visualisation modality: he/she can be interested in a graph in a specific time frame (and in this case he/she will select the static mode) or he can be interested in seeing the evolution of what the graph presents over time, and in which case he can select the dynamic visualisation mode. In this way, the user is able, for example, to see how the number and the territorial distribution of research actors changed in the last 5 years.

3 E-INFRASTRUCTURES AND PROJECTS ASSESSMENT THROUGH STAKEHOLDER'S PERCEPTION ANALYSIS

3.1 Stakeholder Perception Analysis (SPA) Overview

Multi-criteria socio-economic assessment gives decision-makers the opportunity to weight a wide range of different effects against each other in the decision-making process. Particularly the social domain includes a variety of impacts that benefit from a socio-economic assessment rather than a formal cost-benefit analysis, as a large proportion of benefits are not easily measured in financial/quantitative terms. Data availability and the breadth and quality of indicators to measure and monitor innovation performance have to be improved, ranging from technological innovation to other forms of innovation (e.g. social innovation). ERINA+ argues that the quality of socio-economic impact analysis can be substantially improved by applying a standardised methodology supported by methodological adaptations. SPA focuses on issues and challenges on adopting e-Infrastructures to be used in a broad society as well as recommendations on increasing visibility of the impact of e-Science on society at large. This particular section includes an analysis on the opinion expressed by stakeholder groups on e-Infrastructures when evaluating the value network that surrounds them by using a semi-qualitative analytical process. ERINA+ identified three groups of stakeholders in the e-Infrastructure domain, namely user-projects and key stakeholders. These target groups have been addressed to share their opinion rather than asking them to follow predefined lines of directions in answering questions. ERINA+ identified two macro areas/categories of impact, efficiency and effectiveness, with the latter having three explicit sub-categories, i.e. competitiveness, innovation and cohesion. SPA questions attempt to reflect which impact e-Infrastructures and e-Infrastructure projects have on the capacity of the European researchers (and a wider audience), in this sense the "visibility" of a research output can be a good proxy for effectiveness.

	Key stakeholder's visibility	Group visibility of projects	Single visibility of Users, VRCs
Competitiveness	Support of global competitiveness, developing inner strengths	Network activities	Single visibility, competitiveness
Innovation & Transfer	Transformation of workplace, agenda	Extension of research agenda and typology	New skills development, research agendas
Cohesion	Use within broad society, integrate research area	spatially enhanced collaboration	Renewed, advanced collaboration patterns

Table 1: Question Development Matrix of Effectiveness

The questions reflect issues and challenges on adopting e-Infrastructures to a broad society as well as recommendations on increasing visibility of the impact of e-Science on society at large. The questions addressed also reflect the interest not only on technological added value of e-

Infrastructures but on their function as trend multipliers within changes in society regarding health and education among other essential topics of the future. All Figures show the median of the answers as a descriptive statistical value taken from the ERINA+ main indicators and, if available, supported by textual comments.

3.2 Users and Virtual Research Communities (VRCs)

With the increased development of Research and Data infrastructures, users become important players in the development of e-Infrastructures. Bridging the gap between developer and user needs, advancing publishing, continuing training and challenging the barriers of science to enter the market are key issues in getting user involvement. Benefits of using e-Infrastructures, developing and use of services thereof include extending the research typology and agenda. This is also reflected in other deliverables (e.g. D6.2) but has to be considered when evaluating the impact of users towards effectiveness of e-Infrastructures. The increased performance of using e-Infrastructures & Service strengthens the user's ability to participate in knowledge creation and dissemination by advancing the research typology. It challenges user's collaboration patterns, strengthens the global competitiveness of researchers and allows users to develop new skills and research agendas. These issues are addressed by questions related to the group of stakeholders designed to add information to the ERINA+ categories of assessing efficiency and effectiveness.

The Data available include responses from 163 Users of different domains. Among the different groups of stakeholders, users show a great confidence in the effectiveness of e-Infrastructures. Users show the highest perception rates on all three categories meaning the median on answering the questions is higher than in any other target group on competitiveness, innovation and cohesion (see Figure 6). It is interesting though, that users do feel more competitive rather than innovative with the average number of hours saved being about 300 per year. This number depends on the projects but, in general, the fast accomplishment of tasks is being perceived as having a high impact on the competitiveness. In terms of cohesion, the rate is equally high. User questions did not allow for any comments, though. From a sustainability point of view it would be suggested to further open up the ERINA+ questionnaire to users of VRCs, Research and Data, which included only a very limited number of VRCs[1].

[1] D3.4, chapter 3, p.41

Figure 6: Median Responses of User Questions (grouped by effectiveness)

3.3 Projects

The analysis of 21 projects was done mainly via quantitative measurements (chapter 4). Providing e-Infrastructures pays off by supporting the development of interoperability and standards. This is not reflected in SPA. From a SPA point of view it is remarkable, that projects evaluate their degree of innovation as lower than e.g. competitiveness. With respect to the question framework there is an interesting gap between the possibilities of e-Infrastructures (generally perceived high) and the actual extension of research agenda and typology. Another interesting gap is the well-developed spatial pattern extension as indicated by the projects. Nevertheless, the impact of cohesion is perceived as low (see Figure 7). As pointed out later in the deliverable, the degree to which the impact is 'low', is not suggesting a strong evaluation, though.

Figure 7: Median Responses of Projects responses (grouped by effectiveness)

3.4 Key Stakeholders

The community is given means to advance ICT to meet social and technical challenges as well as to support the Commission's Digital Agenda issues (e.g. Aging Society Support) by e-Infrastructures. From a SPA point of view the answers of key stakeholders to questions on effectiveness show a high appreciation of innovation, competitiveness and cohesion. The key stakeholders are considered as being the main e-Infrastructures as pointed out in D2.2 and D3.4 (chapter 3). Despite the lack of (statistically) significant amount of responses to the Stakeholder Data Gathering Interface, the answers, which are supported in SPA by interviews, show some trends which contribute to the impact evaluation. All main ERINA+ indicators do support the perception of a major impact on the future development as seen by the stakeholder groups.

The impact of e-Infrastructures on **competitiveness** is perceived as being very likely (Figure 8). The main challenges in terms of governance will be likely a reorganisation of governance bodies in terms of supporting e-government or committees, addressing issues like data protection and ethics (including data privacy). There is a general opinion trend that "*existing authorities may handle this*" but need to have clear mandates by the EC to avoid redundancies (see also D6.2.). In terms of future funding, new ways of funding are considered being likely including "*IMF*[2], *EIB*[3]" as well as "*national funding and local institutes*". Surprisingly, "*not too much industrial participation is expected*". The major challenges of future e-Infrastructures development are the "*inability to become efficiently integrated as a service into European research initiative*" and "*the sustainability of the models, the lack of eProjects in taking care of sustainability*" and, very likely, "*the lack of funding and commitment from Member States and the EU*". This includes both the community based development of e-Infrastructures and the adaption of funding models in supporting a legal framework to allow for new ways of interacting of users and e-Infrastructures (see also policy recommendations in 6.2.).

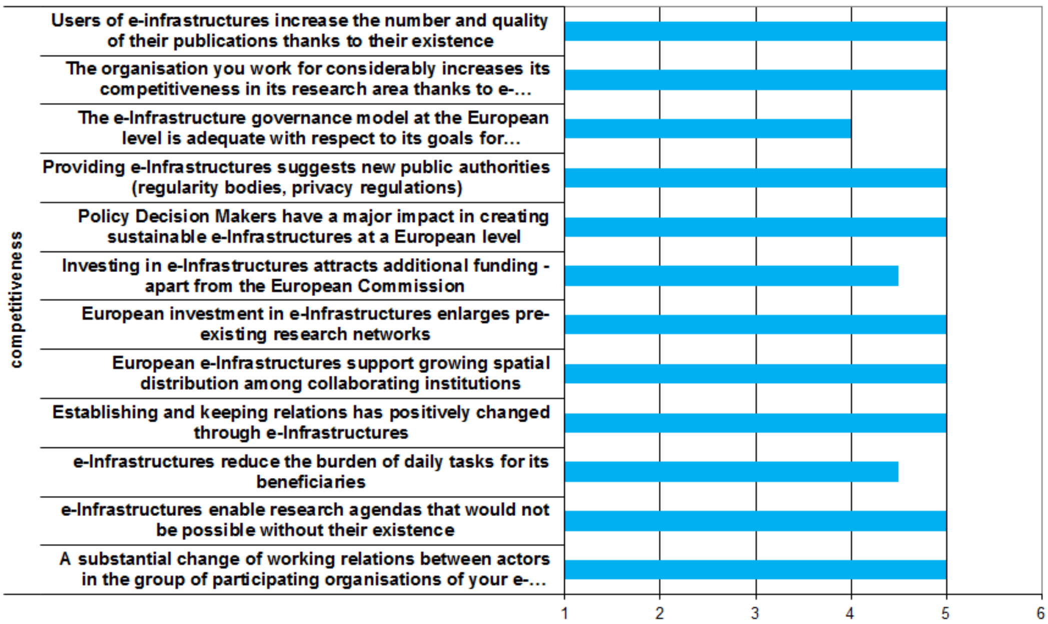


Figure 8: Median response of Stakeholder questions on competitiveness

The impact on **innovation** is also considered likely (Figure 9), especially from the perception of key stakeholders. "*User needs have to be at the forefront*" given that "*the role of*

[2] International Monetary Fund
[3] European Investment Bank

researchers is seen as changing: researchers become data curators and resource operators". A challenge of integrated services will be that e.g. *"physicians can conduct their own research projects, without being dependent on supporting researchers".* It is perceived likely that *"eIS act as facilitators for scientific education"* as well. Legal, economic and cultural **barriers are not seen to lower impact** at a significant level, though. As a governance barrier to innovation the stakeholders evaluate that "*Resources funded by the government cannot be used for non-academic users"* due to *"different national data protection laws, different policies and access rules of data providers"* and *"commercial activities cannot be done in the network*". From a societal point of view the increased impact on innovation is not perceived as likely as for improved working conditions in eScience.

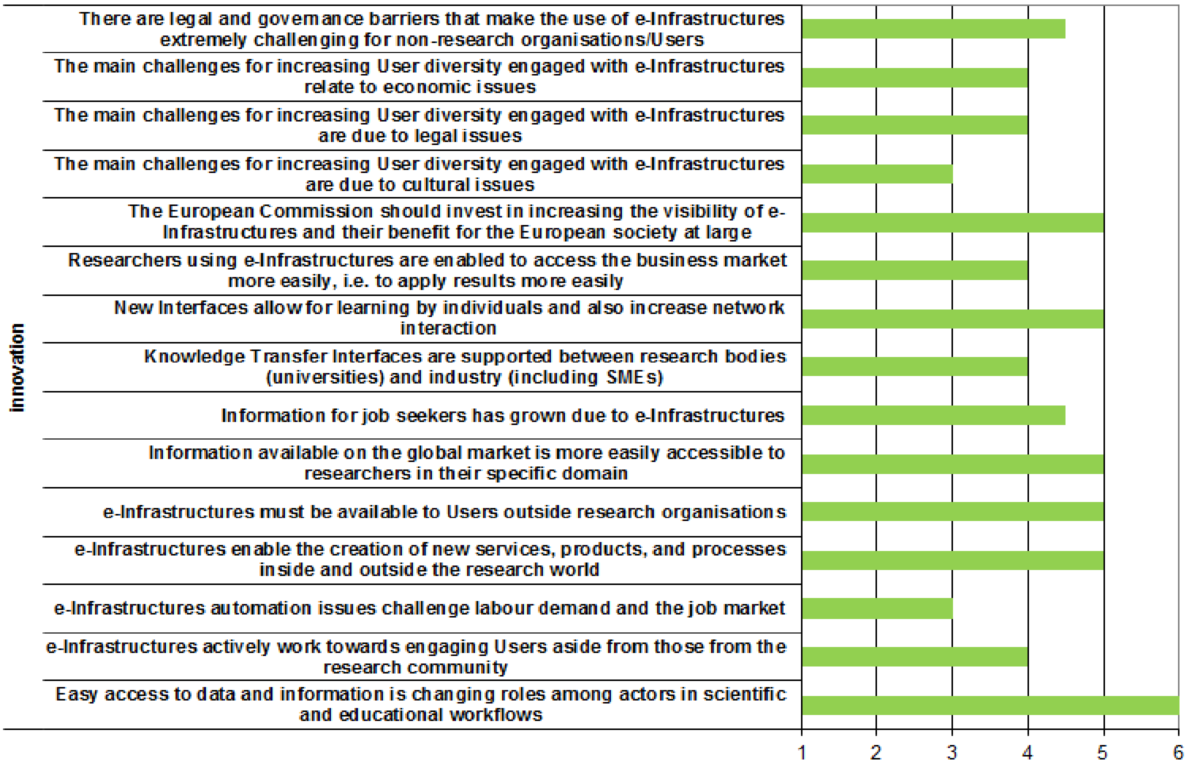


Figure 9: Median response of Stakeholder questions on innovation

In terms of **cohesion** the major benefits are likely (Figure 10) to be seen "*to get a good mesh of services between several infrastructures" based on "Funding, interaction and collaboration of own infrastructures with other e-Infrastructures and research initiatives for long-term sustainable research projects*." The impact on cohesion is likely due to "*give researchers irrespective of their location highly advanced data services*" despite "*in certain cases they increase the digital divide, e.g. for people at locations with slow connection*". In terms of cohesion, e-Infrastructures are likely to have an impact on society by using "*large data sets […] for novel research in an efficient, safe and regulation-compliant way to improve health and living conditions of European citizens*". It is perceived also, that e-Infrastructures allow for "*easier access […] to restricted group of persons*".

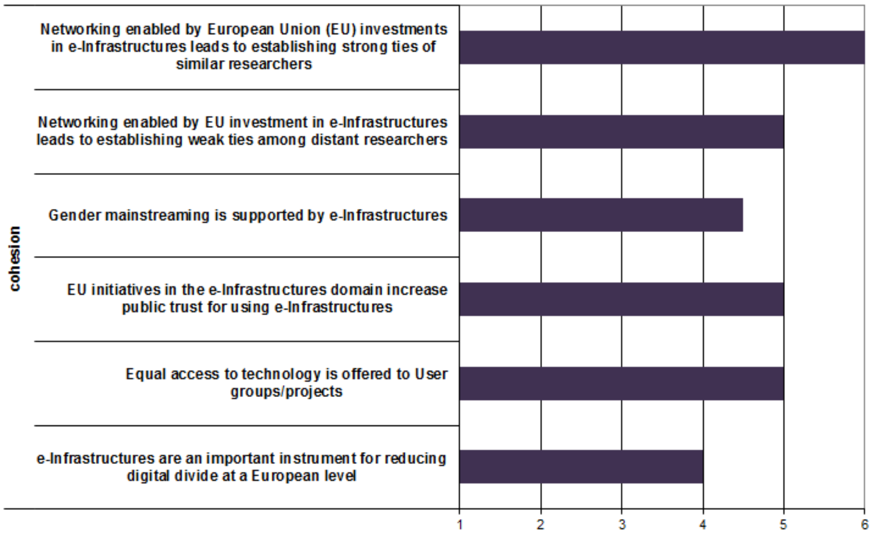


Figure 10: Median response of Stakeholder questions on cohesion

3.5 Overall Perception on e-Infrastructures' effectiveness

In general, the likeliness of impact of e-Infrastructures (as indicated by their effectiveness) is considered high by all different groups of stakeholders with respect to the questions asked by ERINA+. (Note: The terms "high" and "low" in this summary are derived from functional relationships of the Median values of ERINA+ indicators on the perceived impact of e-Infrastructures on effectiveness as collected via the Online Tools). Even if the impact is considered low (Table 2), we can see that the degree (or extent) to which the relationship is "low", is not very significant, i.e. the perceived impact of projects on innovation is only as good as 0.2, meaning, the representation of this perception is not very strong.
Surprisingly the projects do share a somewhat different perception in terms of evaluating the impact of e-Infrastructures into their work. In particular, the innovation process and the cohesion aspects could be improved as it is perceived as having a little less impact on the effectiveness.

	competitiveness	degree	innovation	degree	cohesion	degree
users	high	*0,8*	high	*0,6*	high	*0,8*
projects	high	*0,5*	low	*0,2*	low	*0,2*
stakeholders	high	*0,8*	high	*0,6*	high	*0,8*

Table 2: Stakeholders Perception on effectiveness of e-Infrastructures

Another visualization (Figure 11) summarizes the contribution of each stakeholder group to the effectiveness of e-Infrastructures by using the median with respect to the overall number of questions. As it has been described in previous paragraphs, the perception of innovation is highest among the key stakeholder responses and lowest with projects. The users show an equally strong contribution to all indicators, whereas the projects share a strong perception of their impact on competiveness.

Figure 11: Weighting the impact of e-Infrastructures on effectiveness

4 E-INFRASTRUCTURE PROJECTS PERFORMANCE ASSESSMENT

4.1 Efficiency

The analysis provided is descriptive and is based on the data filled in the Webtool by the projects to up November 14th. The analysis showed that data is still incomplete, both on the projects side and – above all - from the users point of view. Nevertheless, we can already develop some considerations by analysing both (1) the projects (20) all together and (2) divided in sub categories.

The total Economic Net Present Value (ENPV) generated by the sum of the projects is Euro 526,627,170.00. Compared to the total budget estimated (Euro 154,433,577.00), the projects value returns to the economy a net benefit of more than 3 times (B/C=3.41). This is a positive result because if we consider the investments done (i.e. the costs), the projects - considered as a whole - return economic benefits three times higher.

Currently, is not possible to compare this estimation with the resulting value related to user responses[4].

Here below the aggregated average results:

	Mean	Min	Max	St.Dev.	Median
ENPV	€ 29.257.065	-€ 8.409.470	€ 324.967.000	€ 78.167.740	-€ 1.161.415
B/C	4,48	0,00	20,94	6,70	0,35
ENPV*	-€ 3.734.831	-€ 72.203.400	€ 64.255.500	€ 23.615.094	-€ 3.413.520
B/C*	1,28	0,00	18,40	4,37	0,00
WtP/C*	0,86	0,00	11,63	2,71	0,00

Table 3: Aggregated projects analysis – Economic assessment

There is a significant dispersion, both considering ENPV, that B/C: the significant difference between minimum and maximum and high value of the standard deviation (St.Dev). The negative median on the ENPV can be explained by considering that the projects are currently completing the self-assessment while we are writing this deliverable and the data on which we are working with cannot be considered as final.

[4] Up to November 13th , 169 responses were available to users belonging to seven projects. The total ENPV * has no descriptive validity for the whole sample.

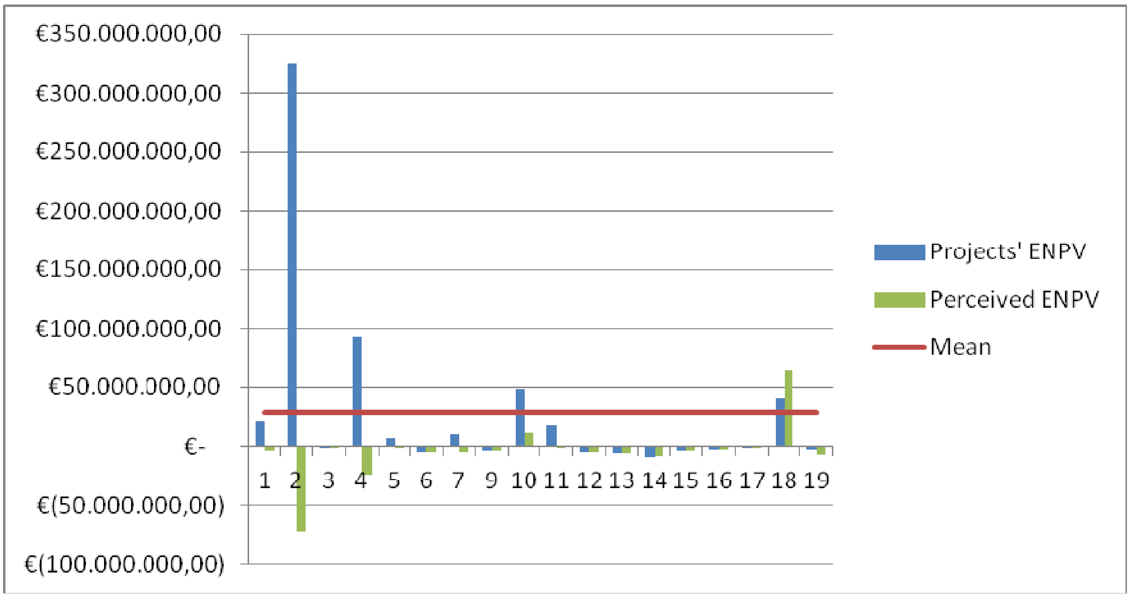


Figure 12 – Aggregated Projects Analysis - ENPV

Figure 12 shows the comparison between projects' offered ENPV and the users perceived ENPV. Most of projects values are aligned; however it should be noted that the two projects that expect to provide the highest ENPVs are perceived negatively from their users in relation to these indicators. These values should be affected also by the low number of user answers. Project 18 showed really positive and coherent values (see also Figure 13).

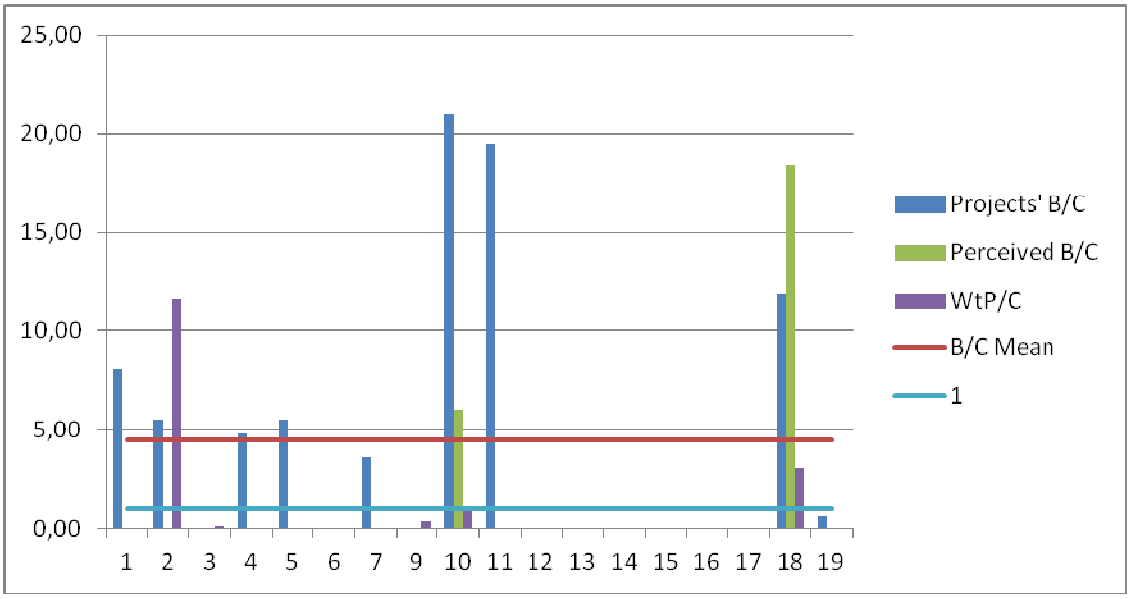


Figure 13 - Aggregated Projects Analysis - B/C

Figure 13 shows the comparison between projects' offered Benefits/Costs ratio (B/C), the users perceived B/C and the Willingness to Pay/Costs ratio. In most of the cases projects' "declared" to offer benefits that at least cover the cost but only in two cases this is confirmed by the users.

With reference to the "perceived" values we realise that they have greater impact in the analysis of each project. In order to deepen the understanding of results the same approach is used in dividing the sample into clusters which allow to identify more significant information.

4.1.1 Efficiency analysis by project clusters

We identified two typologies of clusters. The first typology groups the projects in three clusters according to the budget (x): under 2 million euro, between 2 and 5 million euro, over 5 million euro, which respectively have 5, 10 and 5 projects. According to this analysis it emerges that the best economic performance is obtained by medium sized projects with a budget ranging from 2 to 5 million euros (see Tables 4-9 and Figures 14-25).

The second typology group's projects according to their number of users (y) declared. In the first cluster there are the projects with less than 100 users, in the second there are the projects with 100 to 1000 users and in the third cluster there are the projects with more than 1000 declared users, which respectively have 10, 4 and 6 projects.

Also in this case in emerges that the best economic performance is obtained by medium sized projects with declared users ranging from 100 to 1000 (see Tables 7-9 and Figures 17-22).

The following tables shows the average, the aggregated values and the graphs for each single category.

4.1.1.1 Budget cluster 1: x <= 2 M€

	Mean	Min	Max	St.Dev.	Total
ENPV	€ 562.885,00	-€ 2.440.330,00	€ 7.014.700,00	€ 4.348.001,70	€ 2.251.540,00
B/C	1,53	0,00	5,48	2,65	
				0	
ENPV*	-€ 2.558.975,00	-€ 6.302.560,00	-€ 912.700,00	€ 2.511.961,50	-€ 10.235.900,00
B/C*	0,00	0,00	0,00	0,00	
WtP/C*	0,03	0,00	0,10	0,05	

Table 4: Budget cluster 1 projects analysis – Economic assessment

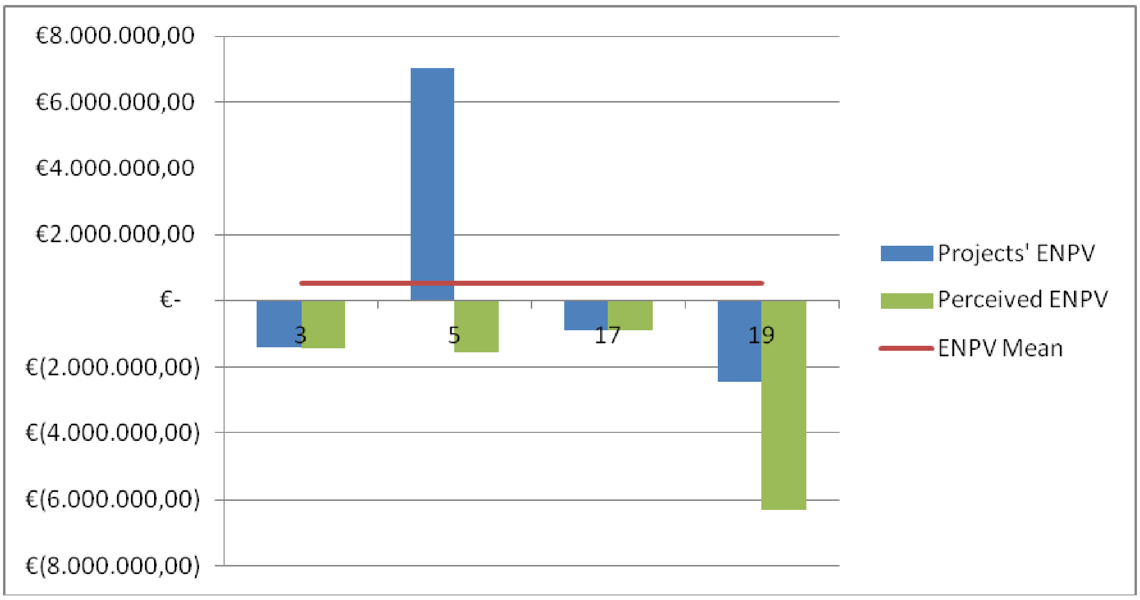


Figure 14: Budget cluster 1 Projects Analysis - ENPV

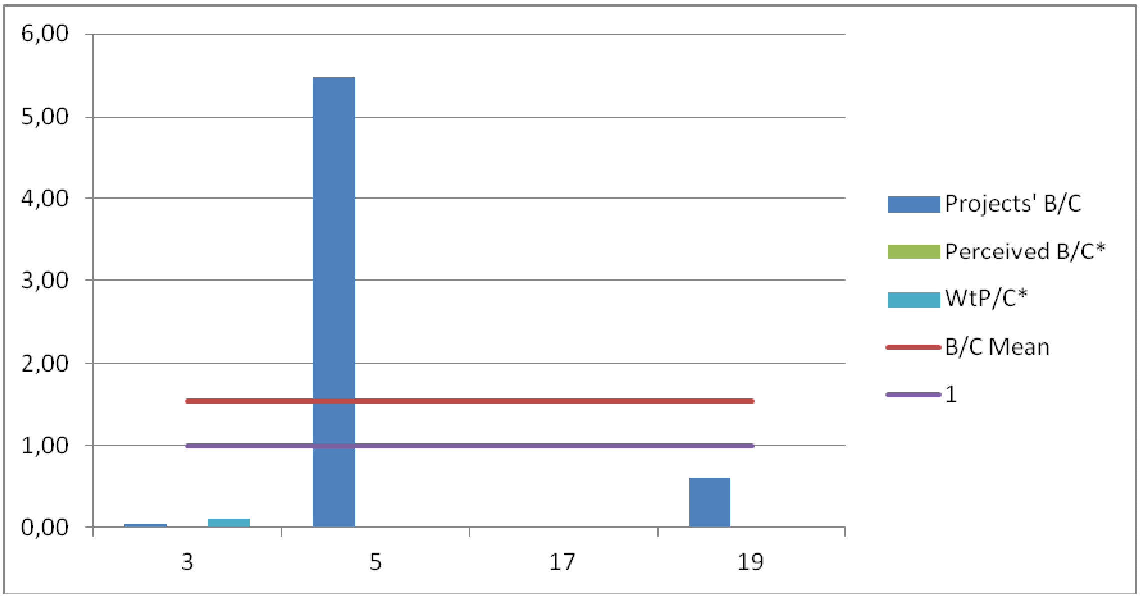


Figure 15: Budget cluster 1 Projects Analysis - B/C

4.1.1.2 Budget cluster 2: 2 M€ < x < 5 M€

	Mean	Min	Max	St.Dev.	Total
ENPV	€ 11.373.553,33	-€ 4.167.240,00	€ 48.526.400,00	€ 20.705.593,86	€ 102.361.980,00
B/C	4,96	0,00	20,94	7,39	
				0	
ENPV*	€ 5.693.827,78	-€ 4.416.840,00	€ 64.255.500,00	€ 22.578.042,77	
B/C*	2,71	0,00	18,40	6,21	
WtP/C*	0,51	0,00	3,07	1,03	

Table 5: Budget cluster 2 projects analysis – Economic assessment

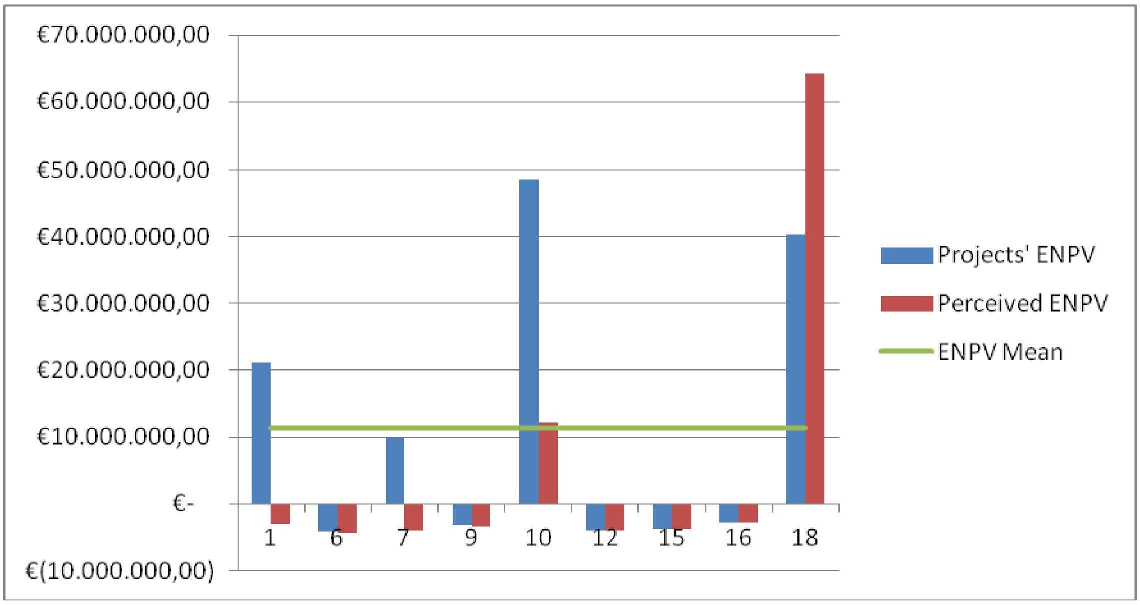


Figure 16: Budget cluster 2 Projects Analysis - ENPV

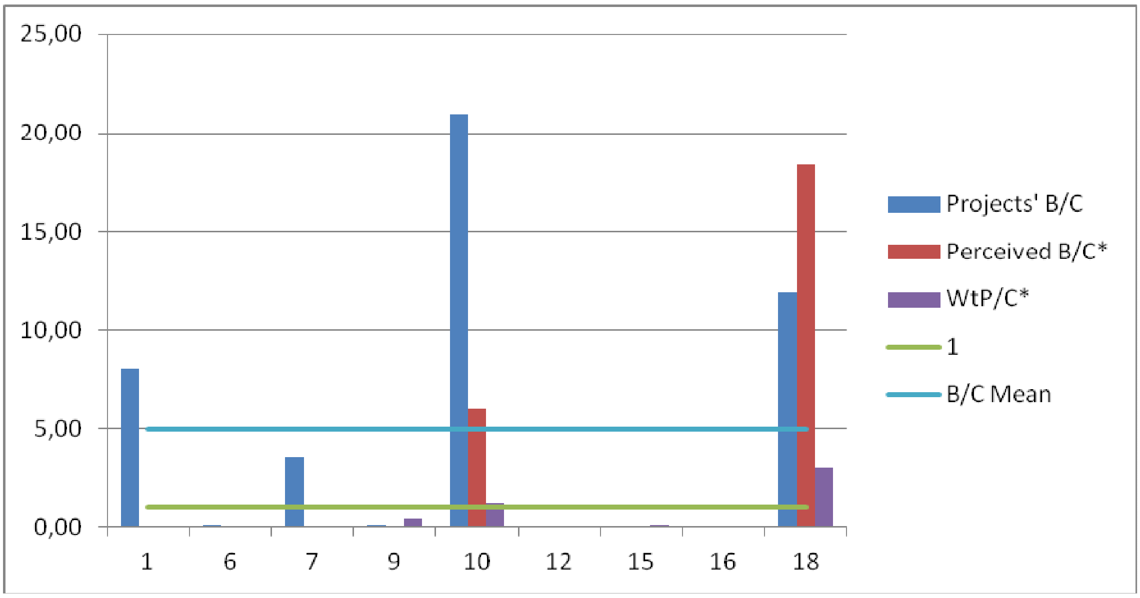


Figure 17: Budget cluster 2 Projects Analysis - B/C

4.1.1.3 Budget cluster 3: x >= 5 M€

	Mean	Min	Max	St.Dev.	Total
ENPV	€ 80.384.384,00	-€ 8.409.470,00	€ 324.967.000,00	€ 143.191.351,76	€ 401.921.920,00
B/C	2,19	0,00	5,50	2,74	
				0	
ENPV*	-€ 23.043.502,00	-€ 72.203.400,00	-€ 5.027.380,00	€ 28.580.912,19	
B/C*	0,00	0,00	0,00	0,00	
WtP/C*	2,33	0,00	11,63	5,20	

Table 6: Budget cluster 3 projects analysis – Economic assessment

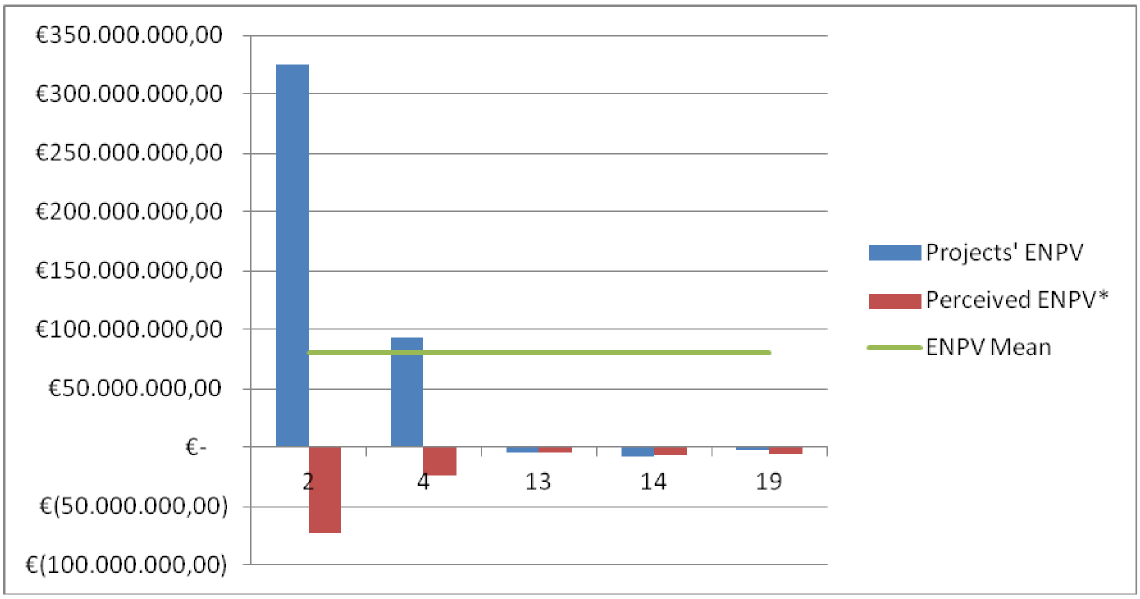


Figure 18: Budget cluster 3 Projects Analysis - ENPV

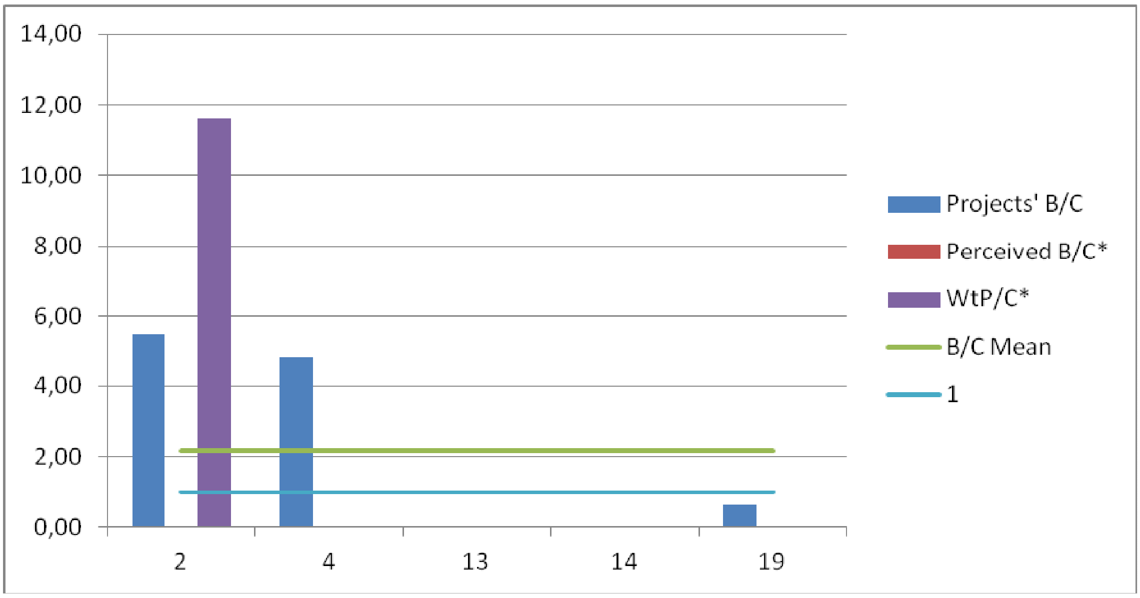


Figure 19: Budget cluster 3 Projects Analysis - B/C

4.1.1.4 Users cluster 1: y <= 100 users

	Mean	Min	Max	St.Dev.	Total
ENPV	€ 9.347.625,00	-€ 8.409.470,00	€ 92.832.100,00	€ 34.025.485,76	€ 74.781.000,00
B/C	1,30	0,00	5,48	2,39	
ENPV*	-€ 6.269.195,00	-€ 24.274.700,00	-€ 912.700,00	€ 7.557.004,74	
B/C*	0,00	0,00	0,00	0,00	
WtP/C*	0,00	0,00	0,00	0,00	

Table 7: Users cluster 1 projects analysis – Economic assessment

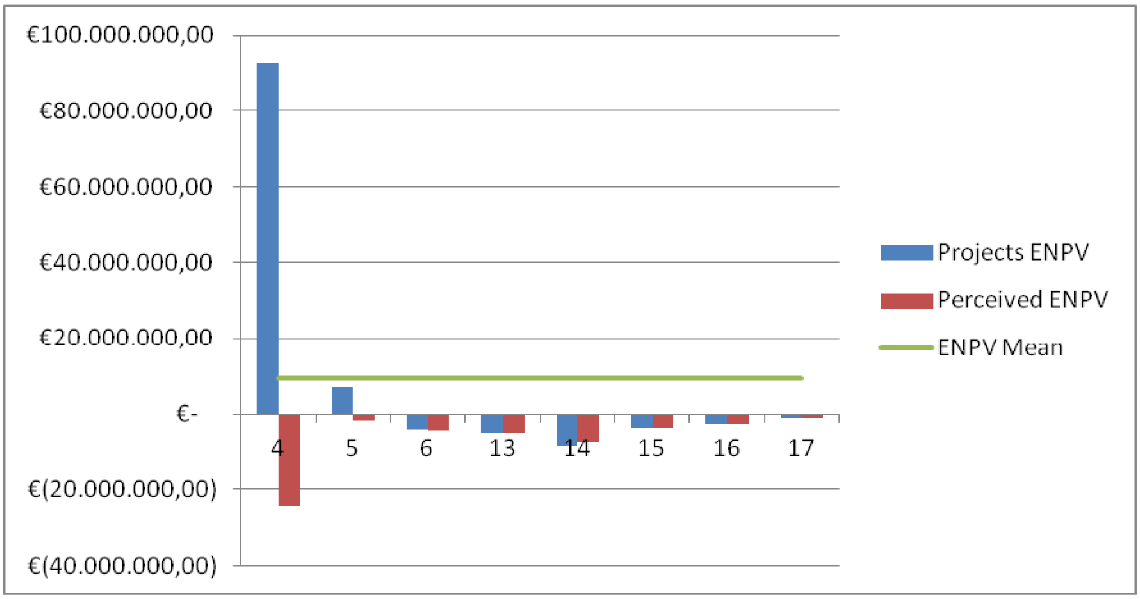


Figure 20: Users cluster 1 Projects Analysis - ENPV

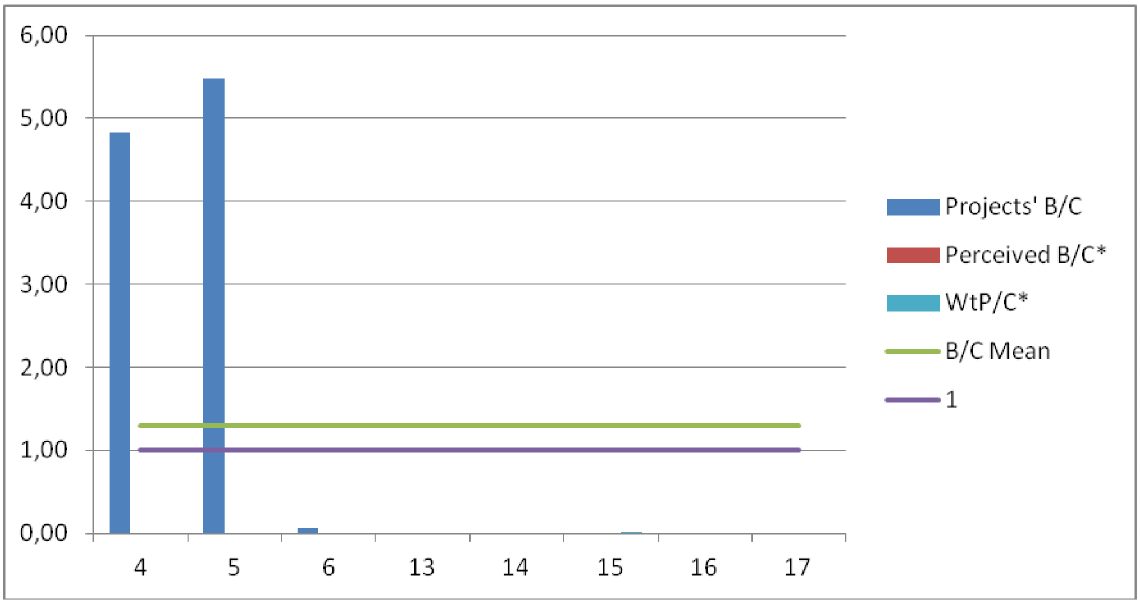


Figure 21: Users cluster 1 Projects Analysis - B/C

4.1.1.5 Users cluster 2: 100 users < y < 1000 users

	Mean	Min	Max	Var	St.Dev.	Total
ENPV	€ 19.336.292,50	-€ 2.440.330,00	€ 48.526.400,00	4,71557E+14	€ 21.715.356,50	€ 77.345.170,00
B/C	8,30	0,61	20,94	80,43	8,97	
ENPV*	-€ 263.042,50	-€ 6.302.560,00	€ 12.184.300,00	7,0801E+13	€ 8.414.335,07	
B/C*	1,50	0,00	6,01	9,018009	3,00	
WtP/C*	0,29	0,00	1,16	0,335409745	0,58	

Table 8: Users cluster 2 projects analysis – Economic assessment

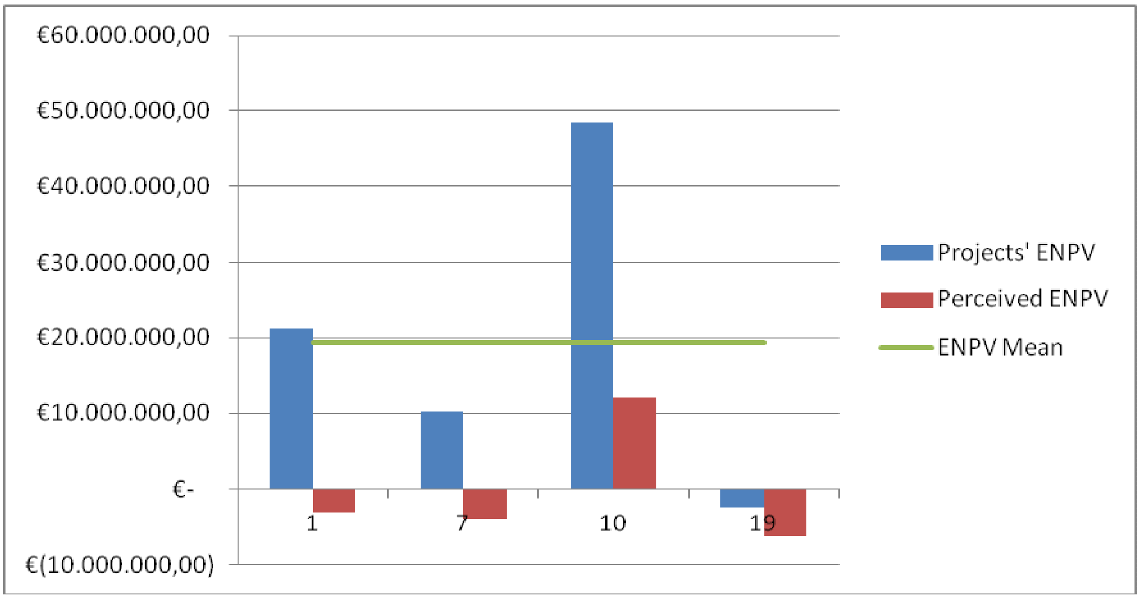


Figure 22: Users cluster 2 Projects Analysis - ENPV

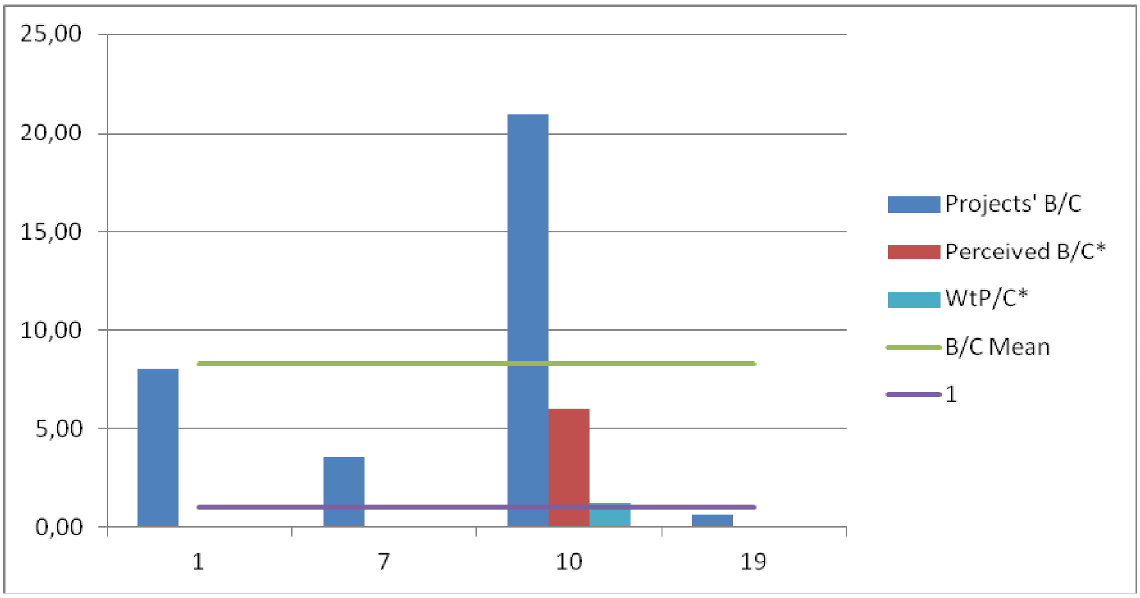


Figure 23: Users cluster 2 Projects Analysis - B/C

4.1.1.6 Users cluster 3: y >= 1000 users

	Mean	Min	Max	St.Dev.	Total
ENPV	€ 62.416.833,33	-€ 3.883.000,00	€ 324.967.000,00	€ 129.763.110,83	€ 374.501.000,00
B/C	6,17	0,00	19,51	8,05	
ENPV*	-€ 2.942.346,67	-€ 72.203.400,00	€ 64.255.500,00	€ 43.173.870,09	
B/C*	3,07	0,00	18,40	7,51	
WtP/C*	2,53	0,00	11,63	4,61	

Table 9: Users cluster 3 projects analysis – Economic assessment

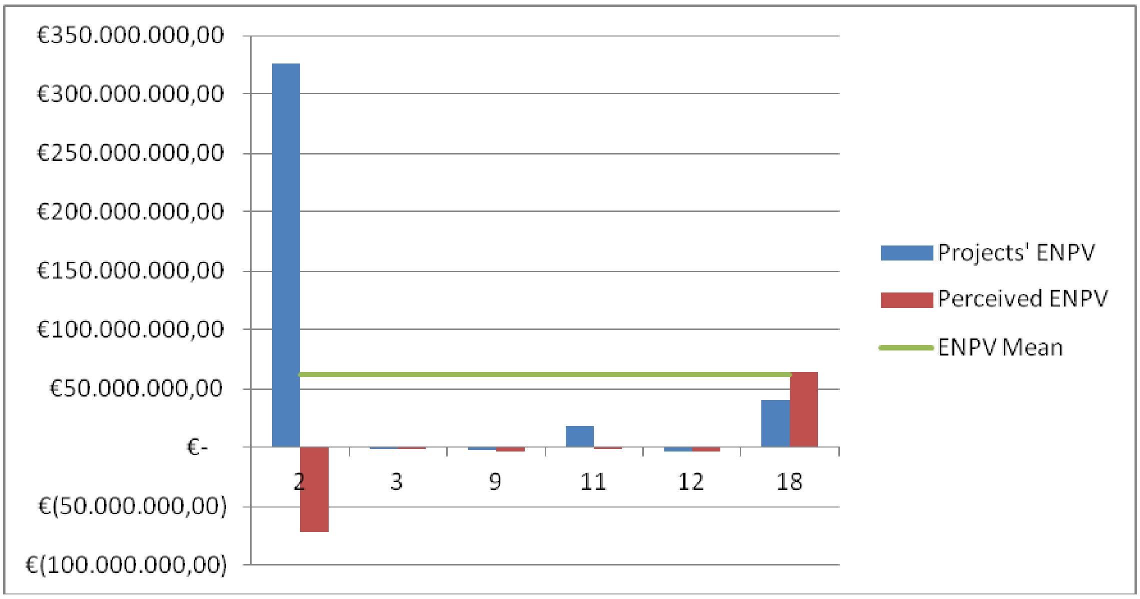


Figure 24: Users cluster 3 Projects Analysis - ENPV

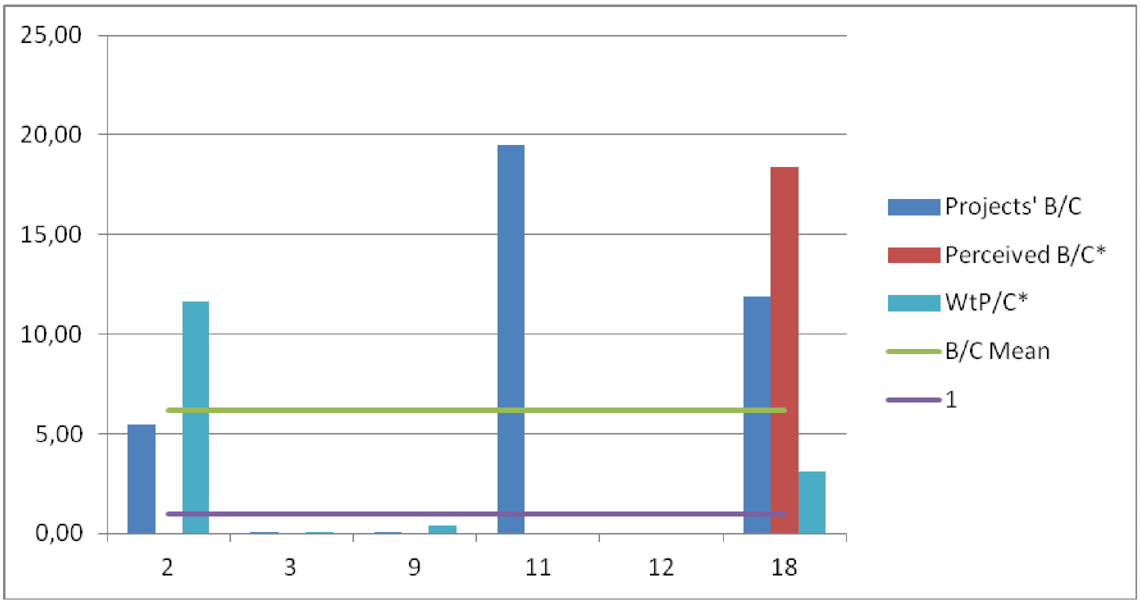


Figure 25: Users cluster 3 Projects Analysis - B/C

4.1.2 Considerations on efficiency

By analysing the summary tables divided into different clusters, it is possible to develop some considerations for each typology of project according to the identified characteristics.

Budget Level	ENPV	B/C	ENPV*	B/C*	WtP/C*	Sum of ENPVs
x <= 2M€	€ 562.885,00	1,53	-€ 2.558.975,00	0,00	0,03	€ 74.781.000,00
2M€ < x < 5M€	€ 11.373.553,33	4,96	€ 5.693.827,78	2,71	0,51	€ 77.345.170,00
x >= 5M€	€ 80.384.384,00	2,19	-€ 23.043.502,00	0,00	2,33	€ 374.501.000,00
Number of Users	**ENPV**	**B/C**	**ENPV***	**B/C***	**WtP/C***	**Sum of ENPVs**
x <= 100	€ 9.347.625,00	1,30	-€ 6.269.195,00	0,00	0,00	€ 2.251.540,00
100 < x < 1000	€ 19.336.292,50	8,30	-€ 263.042,50	1,50	0,29	€ 102.361.980,00
x >= 1000	€ 62.416.833,33	6,17	-€ 2.942.346,67	3,07	2,53	€ 401.921.920,00

Table 10: Comparative analysis among clusters

By analysing all the sizes, it emerges that the medium-sized projects (both per budget spent and served users) have better chances to be economically sustainable (ENPV – ENPV* and B/C – B/C* higher).

With reference to the financial sustainability, the WtP/C* indicator represents a merchantability index calculated on the basis of the average willingness to pay stated by the users of the project (this is the reason for using WtP/C perceived by users (asterisk symbol"*")). The WtP calculates the potential financial income that the project can achieve by selling to all its users the services offered. Compared to the cost of the project, it express if higher than 1, the financial sustainability, or the merchantability of the service. The partial responses obtained show that the indicator is in line with the previous one, indicating how many users are served, and the larger the budget is, the higher the commercial potential of the project is. It also emerges that there is a need to further explore if the value of WtP/C ratio is less than 1 for medium sized projects, as it means that the project needs to be necessarily financed by the European Commission and/or research of new business models.

In general, despite the incomplete data reliability we want to emphasize that all the projects are producing net economic benefits in the real economy, a part of which can be converted into a monetary value.

4.2 Effectiveness

In this section we will describe the performance of assessed projects in terms of effectiveness. As mentioned earlier, the ERINA+ methodology considers three macro indices for effectiveness, which are:

- Competitiveness and excellence of research
- Innovativeness and transfer outside the domain
- Cohesion

The three macro indices are composed of several variables each (See chapter 2 – methodology); we will see them in details in the following tables. For each variable we indicate the total value, i.e. the sum of all the peer-reviewed articles published by all the analysed projects, the mean (for each variable we divided the total value by the number of projects that actually provided a figure for the specific variable) and the maximum value, that is the highest value observed among the analysed projects.

4.2.1 Competitiveness and excellence of research

This macro variable maps the outputs of the projects in terms of scientific production, development of new products and services and development of business opportunities. In terms of scientific production, we considered not only peer-reviewed papers, but also conference proceedings and project scientific deliverables. In this way we can see the knowledge production of projects both in formal contexts such as journals and less-formalised contexts such as conferences and project deliverables. In some contexts, in fact, journals are not the only (or the main context) for knowledge production and sharing within the research community, because – as in the case of software engineers – some conferences are more recognised as an arena for scientific exchange and have more quick processes for recognising scientific results if compared with journals.

The table below shows the results of "Competitiveness of research".

	Total number	**Mean**	**Maximum value**
n. of peer reviewed articles with an Impact factor	72	10,3	48
n. of peer reviewed articles without an Impact Factor	121	6,4	27
n. of non-peer reviewed articles	376	19,8	195
n. of technical deliverables/milestones	862	45,4	139
n. of conference proceedings	127	6,7	52
Average ranking of academic institutions represented in the consortium	n/a	163,4	20
n. of patents and patent applications	0	0,0	0
n. of other IPRs	124	6,5	38
n. spin-offs or starts-ups created following the project development	6	0,3	2
	Number of projects which selected 5 or 6 (Likert scale from 1 to 6)		% of answering projects
n. of projects likely to open up and/or establish new types or fields of research	2		11%

Table 11: Competitiveness of research (aggregate evaluation, mean, maximum value)

Looking at the scientific production of analysed projects, we can see that the total number of peer-reviewed articles with impact factor is 72, and the mean value is 10,3 papers per project. However, there is one project that produced, alone, 48 papers this indicating a high variance within the sample used. If we eliminate the outlier value, we obtain quite a different result: the mean value decreases to 3,4 articles per project. This figure is the most accurate to describe the actual scientific production of analysed projects with reference to articles published on journals with an impact factor and the result of one project is really exceptionally positive. This result, 3,4 articles per project is not very high, but we have to consider that most of the projects we collaborated with were still in progress at the time of the assessment and papers publish normally in the last part of project life-time or even after. Finally, for some projects, such as large consortia, it was difficult to gather this information that will be available at management level (the one normally filling in the Webtool) only at the end of the project.

If we focus our attention on articles submitted to journals without an impact factor, the figures grow considerably and they increase even more if we consider non peer-reviewed articles. It is clear that the community under analysis is putting a considerable effort to disseminate the results of their project to the scientific community and beyond. In terms of impact on the scientific community, however, there is room for improvement in terms of articles published with an impact factor. In considering the possibility for improvement in this sense, it has to be mentioned that the e-Infrastructure projects we collaborated with stressed in more than one occasion their role in the scientific domain as facilitators of research activities more than as direct protagonist of the research itself. In other words, e-Infrastructure projects develop instruments that enable research but, often, are not directly devoted to research activities. For this reason the data here described should integrated with the ones of the projects' users.

In fact, we asked the projects' users to tell us how the projects outputs supported them in creating research products such as papers, IPRs, start-ups, etc. Before moving to the results, is important to underline that only a limited number of projects engaged their users, therefore we can count on 178 users in total. More specifically, one project engaged with more than 100 users, while 2 projects engaged with 5 or more users and 3 engaged less than 5 users. Users could be singular users or representative of Virtual Research communities or of an organisation using e-Infrastructure projects' outputs. Considering the total number of users, we can see that - thanks to projects outputs – they succeeded in developing 11 patents or patented applications. The number of IPRs produced is equal to 55, while the respondents acknowledged that - thanks to project outputs – they created 33 spin-offs or start-ups. In terms of scientific production, we explicitly asked to map articles which contents would not have been possible to develop without the use of the specific project scenario/service in question. The table below summarises the results obtained.

Number. of peer reviewed articles with an Impact Factor	7
Number. of peer reviewed articles without an Impact Facto	68
Number. of non-peer reviewed papers/articles	76

Table 12: Users scientific production

These results are particularly interesting because they show the concrete impact of e-Infrastructure projects on their users, therefore on the scientific community. Unfortunately we have a relatively low number of replies from users; however the tool can really support projects in understanding to what extent their instruments support researchers.

In terms of deliverables we considered all scientific or technical deliverables by excluding management, dissemination and exploitation deliverables. Each project developed an average number of 45,4 outputs, which is a very high number. If we exclude the outlier projects (bigger and more complex than the others) we see the average decrease to 35,9 that is still a considerable number of outputs. Besides this, each project generated 6,7 conference proceedings for a total number of proceedings equal to 127.

As part of the ERINA+ methodology, research competitiveness has been conceptualised by looking at research outputs, being not only scientific papers, but also patents, patents application and other IPRs. The projects analysed produced zero patents or patent applications; this is not surprising considering the nature of the projects under analysis. We introduced the variable "Other IPRs" with the precise aim of capturing all the innovation that is not ready or not meant to be protected with a patent. More specifically, we defined IPR in a very broad sense as: *"Intellectual property refers to creations of the mind: inventions, literary and artistic works, and symbols, names, images, and designs used in commerce. For example: Industrial property, which includes trademarks, industrial designs, and geographic indications, software applications and tools developed and released using an OSS license".*

124 IPRs have been produced, with an average value of 6.5 IPRs per project. From the phone interviews conducted we can say that the majority of IPRs counted are related to new software products developed by the consortia; the value is probably under estimated because for some projects it was difficult to count the exact number of IPRs and they did not have a database with all the outputs produced by the project and countable as IPRs.

Finally, the projects analysed developed 6 spin-off/start-ups: this result is very interesting because it is a signal of a possible link between the e-Infrastructures domain and the market. In this sense, this variable bridges the "Competitiveness of research" index and the "Innovativeness and transfer outside the domain" index that we will analyse in the next paragraph.

Finally, 2 out of 10 responding projects declared that it is likely or very likely that they will open up and/or establish new types or fields of research. This value, even if not very high, is never the less important.

4.2.2 Innovativeness and transfer outside the domain

Under this macro variable" we consider all the activities performed for linking the e-Infrastructures domain with other domains, particularly with the training systems and the industrial/commercial sector. In other terms, with this macro index we look at the knowledge triangle that links research, training systems and the productive sector. The table below summarises the results achieved by the collaborating projects.

	Total number	**Mean**	**Maximum value**
n. of public events outside the domain	46	3,8	20
n. of training materials	484	26,9	160
n. of training events	144	8,0	26
n. of trained persons	2.250	125	598
n. of industrial partners and SMEs inside the consortium	52	2,5 (13% of partners)	7
n. of collaboration agreements outside the e-Infrastructures domain	41	2,3	7
n. of knowledge repositories or instrument fostering collaboration and knowledge exchange for users	94	5,2	50
n. of dissemination activities	355	29,6	157
Total audience	327.366	29,761	164.341
	Number of projects which selected 5 or 6 (Likert scale from 1 to 6)		% of answering projects

n. of projects likely to have outputs which lower entry barriers to economic markets for their users	3	15%

Table 13: Innovativeness and transfer outside the domain (aggregate evaluation, mean, maximum value)

Collaborating projects organised 46 events with an audience coming from domains other than e-Infrastructures, with a mean of 3.8 events per project. One project, however, performed almost half of the events; if we exclude this project we have a mean of 2,1. Besides conferences, workshops and other events, projects also established formal agreements with actors outside the e-Infrastructures domain: 41 agreements in total, with an average value of 2,3 agreements per project.

As we can see looking at the table above, the attention for training is quite high. Collaborating projects developed 484 training materials, 94 knowledge repositories or instruments fostering collaboration and knowledge exchange for users, 144 training events for a total number of 2.250 trained persons. This figure is very promising in terms of potential impact, in fact, training is fundamental in order to allow a higher number of researchers to use e-Infrastructures; in addition the complexity of e-Infrastructures is an important barrier for a better exploitation of e-Infrastructures (See D6.1 and D6.2) that only effective training can overcome. Looking into the details of the training events, the average value of 26,9 is influenced by an outlier, whose performance if excluded, brings the average to 18 events per project, which is still a very high number.

Dissemination is another important element for measuring project impact. In fact only by disseminating project results and ensuring visibility to projects' results is it possible to imagine a take-over, an enlargement of the user base and a transfer outside the e-Infrastructures domain. 355 dissemination activities have been performed, reaching a total audience of approximately 327.300 persons. Under the variable "dissemination activities" we consider different typologies of activities by using the classification used by the EU in the FP7 final report template. The table below shows the distribution of the different typologies of dissemination activities.

	Total	Average	Highest Score
Conference	54	4,5	22
Workshops	62	5,2	40
Web	27	2,3	6
Press Releases	12	1,0	7
Flyer	20	1,7	8
Articles published in popular press	45	3,8	40
Videos	11	0,9	4
Media briefings	0	0,0	0
Presentations	72	6,0	37
Exhibitions	11	0,9	4
Thesis	0	0,0	0
Interviews	1	0,1	1
Films	1	0,1	1
TV Clips	0	0,0	0
Posters	30	2,5	22
Others	9	0,8	2

Table 14: Dissemination activities organised by the projects

The weight of the different typologies of the dissemination activities is visualised in the figure below from which we can say that face-to-face activities are the preferred ones by the e-Infrastructures community.

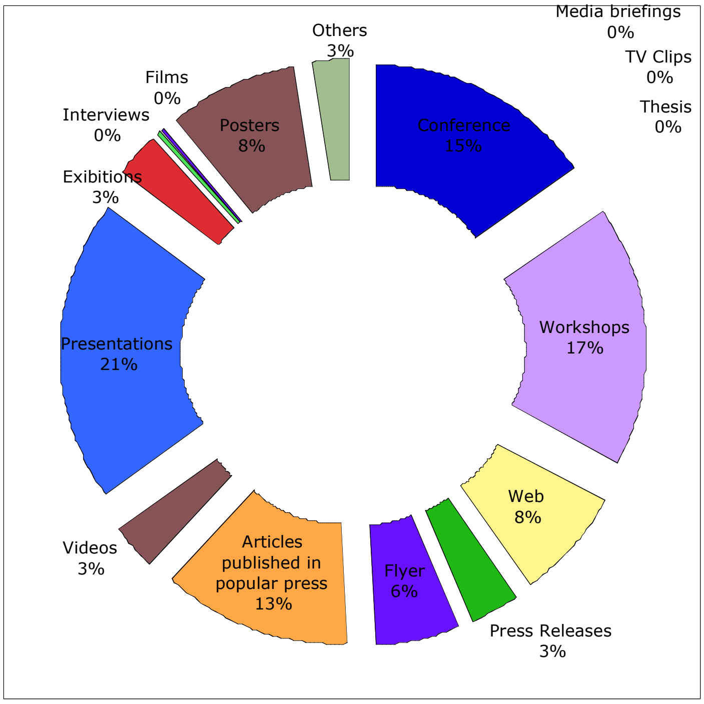


Figure 26: Typologies of dissemination activities organised by the projects

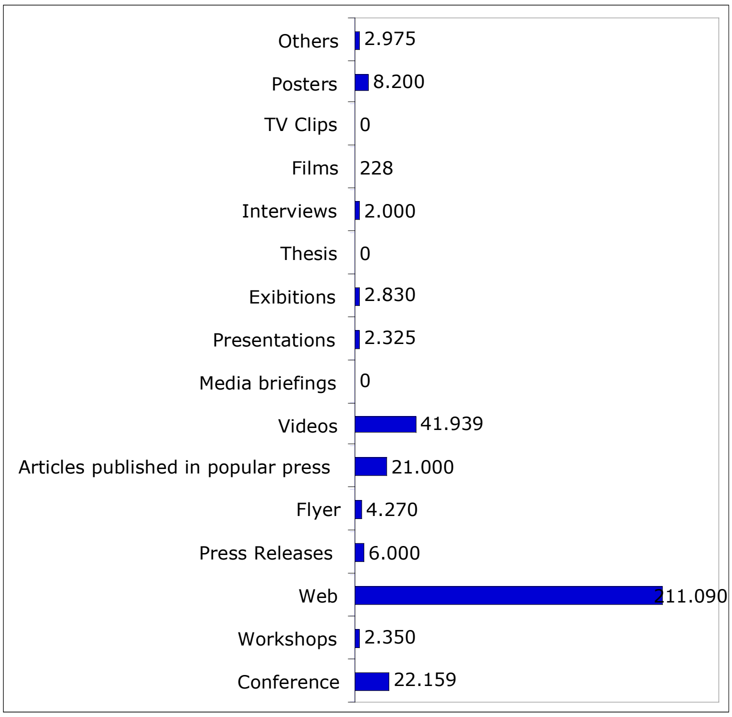


Figure 27: Size of audience of the dissemination activities

The graph that follows shows the number of persons reached by the different typologies of dissemination activities. The web is the channel that reaches a higher number of persons, but also videos and articles in the public press, and conferences reach a significant audience.

Finally, we asked the collaborating projects to describe the primary and secondary audience of their dissemination activities. As evident in the figure that follows, the scientific community is the most relevant primary audience, while users represent the most important secondary audience (see also chapter 5). Only 8% of events address industrial actors, while students, civil society and policy makers are addressed only in few cases. This data shows room for improvement because, even if the scientific community is surely the most relevant audience of e-Infrastructure projects, the general public and people in the training systems should be aware of the progress achieved in the domain. This can support a wider usage of e-Infrastructures in the future and can improve the understanding that society has of the scientific domain in general and of the e-Infrastructures in particular. It is, however, promising, that 19% of the dissemination activities address the media as secondary audience because media can be an important channel for reaching European citizens and the general public.

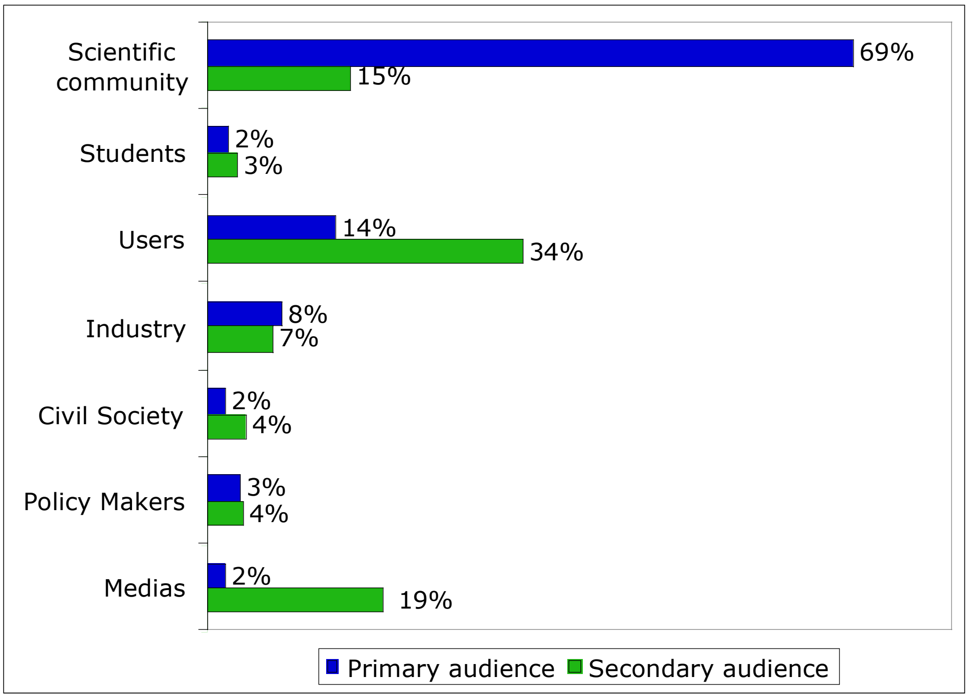


Figure 28: Audience of the projects' dissemination activities

4.2.3 Cohesion

In this section we will consider the third and last effectiveness macro index. By using this macro index we look at the impact of e-Infrastructures in terms of enlarging and reinforcing the collaboration among researchers and project participants within and outside Europe. We include under "cohesion" also the impact that e-Infrastructures projects have in including woman and young researchers in science.

First of all, we can see that e-Infrastructure projects connect partners from all around the world: 14 projects (out of 21) include in the consortium partners from outside the EU and 11 projects have at least one partner from new EU member states. Moreover, projects analysed developed 51 agreements with actors outside the EU.

	Total number	**Mean**	**Maximum value**
n. of nations represented in the consortium	66	10,2	46
n. of partners from new EU members States		2,7	25
n. of partners from outside the EU		4,6	41
n. of agreements with actors outside the consortium representing countries outside the EU	51	2,8	29
n. of European countries covered by dissemination activities at national level	14	2,5	10
n. of dissemination activities with an audience at European level	207	18,8	121
n. of dissemination activities outside Europe	85	7,7	45
n. of women in research-related role	131	6,2	29
n. of young researchers	226	15,1	76
	Number of projects which selected 5 or 6 (likert scale from 1 to 6)		% of answering projects
n. of projects likely to connect and provide exchange opportunities for users from different domains	3		15%
n. of projects likely to expand their range of services to audiences outside the research domain	4		21%
n. of projects likely to expand the geographical range of their users and of their collaboration activities	8		42%
n. of projects likely to allow for coordination of scattered community	5		26%

Table 15: Cohesion (aggregate evaluation, mean, maximum value)

We included in this indices also information about the geographical coverage of dissemination activities and we can see that 207 activities had an European audience, 85 activities addressed an international audience outside Europe and the activities performed at country level engaged 14 European countries. With reference to activities performed in EU countries the following ones have been covered: Austria, Belgium, Denmark, France, Germany, Hungary, Ireland, Italy, Lithuania, Romania, Slovenia, Spain, The Netherlands, and UK.

Countries outside the EU targeted by projects' dissemination activities are: Switzerland, USA, Canada, India, Taiwan, Vietnam, Turkey, South Africa, Chile, and Mexico. Finally, some projects mentioned more generally: Asia, the Middle East and the Latin America.

With reference to data related to woman and young researchers employed in the projects under analysis, we need to stress the difficulties that projects encountered in gathering this information. In fact, information about the age of the personnel is not always available to project managers and it is not easy to obtain from partners, especially in large projects.

Furthermore, also statistics about woman are not always performed at project level, so that the results here described should be considered partial.

Having said that we can say that women represent a minority in the e-Infrastructures domain: with a total number of 891persons in research roles, only 131 are women. Therefore, the number of women in a research role represents the 14.7% of the overall staff working in research-related roles.

In the figure below the distribution of men and women in various project roles is provided.

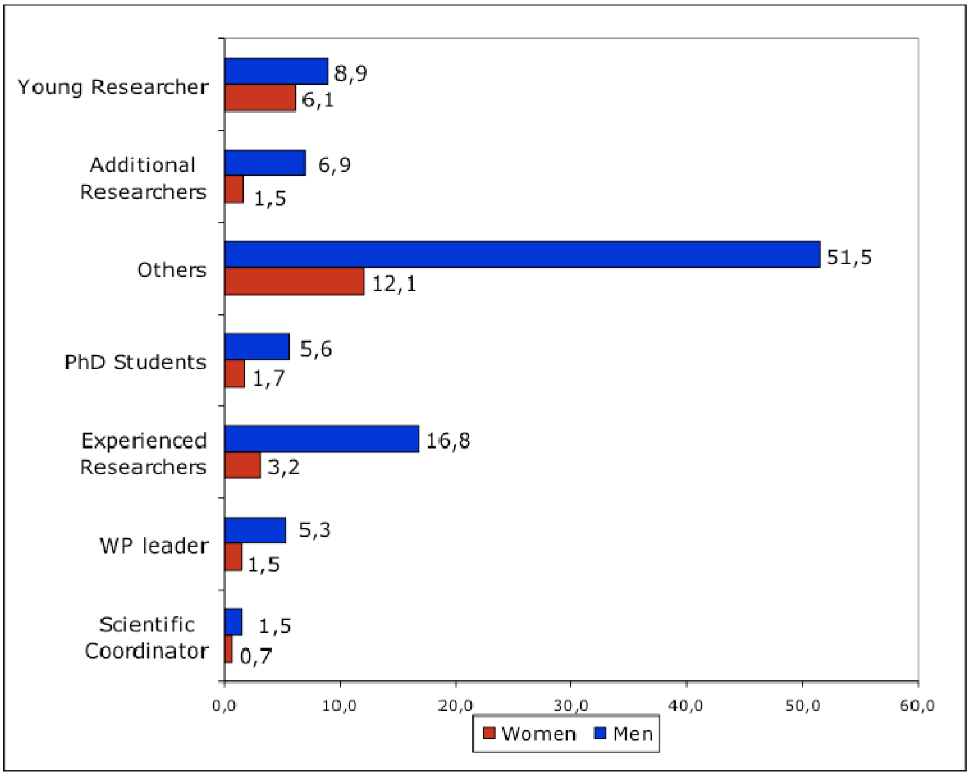


Figure 29: Men and Women in project consortium in specific roles

The total number of young researchers engaged is 226: 11 projects engaged young researchers with an average of more than 15.1 young researchers in their teams. This is very promising in terms of future impact of e-Infrastructures because it shows the growth of a new generation of experts working in the field.

Finally, 3 projects declared that they are likely or very likely to connect and provide exchange opportunities for users from different domains; 4 projects think to expand their range of services to audiences outside the research domain; 8 projects are likely to expand the geographical range of their and of collaborating activities and 5 projects will serve as opportunities for coordinating scattered communities.

4.2.4 Analysing effectiveness by clustering analysed projects

In this paragraph we will analyse the three macro indices by clustering the projects as we did when looking at efficiency. The criteria followed in clustering the projects are two:

- budget;
- number of users.

In terms of competitiveness of research we can see that – for some variables – the results improve when the budget increases too. So the number of deliverables, the number of peer reviewed articles without an impact factor and the number of IPRs grows in a proportional manner with the increased of the budget. This is visualised in the table below by different assigned gradient of grey for the performance of the three groups on each variable. However, we can see that this is not true for other variables such as the number of conference proceedings, the number of spin-offs for which the projects with a budget between 2 and 5 million seem to perform better than the bigger ones. With reference to the peer-reviewed articles with an impact factor there is a zero for projects with a budget of more than 5 million because for large consortiums it was very difficult, if not impossible, to provide the data about all the papers submitted in journals with an impact factor. So, this data cannot be considered conclusive.

	Budget under 2M€		**Budget between 2 and 5 M€**		**Budget over 5M€**	
	Average	Maximum	Average	Maximum	Average	Maximum
n. of peer reviewed articles with Impact factor	1,0	1	11,8	48	0	0
n. of peer reviewed articles without Impact Factor	4,4	10	5,3	21	11,5	27
n. of non-peer reviewed articles	8,8	34	8,8	5	61,0	195
n. of technical deliverables/milestones	24,8	57	44,1	84	74,3	139
n. of conference proceedings	4,4	9	10,2	52	0,8	3
Average ranking of academic institutions represented in the consortium[5]	149,3	20	158,5	68	220,0	154
n. of patents and patent applications	0	0	0	0	0	0
n. of other IPRs	2,6	8	6,1	20	12,5	38
n. spin-offs or starts-ups created following the project development	0,2	1	0,5	2	0.	0
	n. of projects who selected 5 or 6 (likert scale going from 1 to 6)					
n. of projects likely to open up and/or establish new types or fields of research	0		2		0	

Table 16: Competitiveness of research – cluster 1

[5] Regarding the ranking of academic institutions, the institution with the best ranking position is the one with the lowest figure, since the academic institutions are rated from 1 to 500, 1 being the first and 500 the last one.

In terms of innovativeness and transfer outside the domain we see the same dynamic of the previous macro index, with some variables increasing together with the budgets and some others showing how projects with a budget between 2 and 5 million appear more effective than bigger ones. The table below visualises the performance of the three groups for each variable. Also in this case we can say that the budget is not able to describe the whole performance of a project; in other terms, the impacts do not always grow in a proportional way to the growth of the budget.

	Budget under 2M€		**Budget between 2 and 5 M€**		**Budget over 5M€**	
	Average	Maximum	Average	Maximum	Average	Maximum
n. of public events outside the domain (to a wider typologies of stakeholders)	3,5	9	4,6	20	0	0
n. of training materials	2,8	5	44,5	160	8,3	10
n. of training events	4,6	15	8.0	20	13.7	26
n. of trained persons	12	25	148	430	237	598
n. of industrial partners and SMEs inside the consortium	2,8	7	1,5	3	4,0	7
n. of collaboration agreements outside the e-Infrastructures domain	1,4	2	2.9	7	1,7	4
n. of knowledge repositories or instrument fostering collaboration and knowledge exchange for users	4,0	8	7.0	50	3,0	5
n. of dissemination activities and total audience	12,0	20	42.0	157	14,0	14
Total audience	17,883	47,350	15,625	51,145	164,341	164,341
	n. of projects who selected 5 or 6 (Likert scale going from 1 to 6)					
n. of projects likely to have outputs which lower entry barriers to economic markets for our users	1		1		1	

Table 17: Innovativeness and transfer outside the domain research – cluster 1

The table below visualises the performance of the three groups on the macro variable "Cohesion". We can see that the capability of a project to engage a high number of countries and to have a more diversified consortium in term of geographical coverage seems to be influenced by its budget. In fact, not surprisingly, projects with a higher budget tend to have a bigger and more diversified consortium. However, if we look at the geographical focus of dissemination activities and to the percentage of woman and young researchers in project consortium we see that budget is not the intervening factor. Also in this case, we have to remember that for big projects it was very difficult, and in some cases impossible, to calculate the number of woman and young researchers in their consortia so that the related data should be considered partial.

	budget under 2M€		**budget between 2 and 5 M€**		**budget over 5M€**	
	Average	Maximum	Average	Maximum	Average	Maximum
n. of nations represented in the consortium	**5,4**	12	7,4	15	21,0	46
n. of partners from new EU members States	0,6	2	1,2	4	8,0	25
n. of partners from outside the EU	1	4	3,8	23	10	41

n. of agreements with actors outside the consortium representing countries outside the EU	0,8	3	1,0	5	12,3	29
Project Network density						
n. of European countries covered by dissemination activities at national level	1	3	3,2	10	4	4
n. of dissemination activities with an audience at European level	7,0	13	28,5	121	8	8
n. of dissemination activities outside Europe	2,3	5	12,5	45	1	1
n. of women in research-related role	5,8	16	7,3	29	3,2	7
n. of young researchers	5,6	15	13	76	34	68
	n. of projects who selected 5 or 6 (likert scale going from 1 to 6)					
n. of projects likely to connect and provide exchange opportunities for users from different domains	1		2		0	
n. of projects likely to expand their range of services to audiences outside the research domain	1		2		1	
n. of projects likely to expand the geographical range of their users and of their collaboration activities	2		4		2	
n. of projects likely to allow for coordination of scattered community	1		3		1	

Table 18: Cohesion – cluster 1

Now we will consider another cluster developed using, as clustering criteria, the number of projects' users. We have three classes of projects: the first group being projects with less than 100 users, the second one being projects with more than 100 and less than 1.000 users and the third one with more than 1.000 users.

In the table below we see the results for the macro index "Competitiveness of research". The results achieved seem to be independent by the number of users engaged, in fact we cannot recognise a trend linking the number of users with the overall performance of projects. We can say that research outputs (the first 5 variables) are better achieved by projects with a number of users between 100 and 1.000; while the number of IPRs growth with the growth of users' number and the number of spin-off is higher in project with a restricted number of users.

	Less than 100 users		**Between 100 and 1000 users**		**More than 1000 users**	
	Average	Maximum	Average	Maximum	Average	Maximum
n. of peer reviewed articles with Impact factor	3,5	7	19,3	48	0,0	0
n. of peer reviewed articles without Impact Factor	6,1	21	8,3	27	5,5	15,0
n. of non-peer reviewed articles	5,6	22	9	27	48,2	195
n. of technical deliverables/milestones	34,4	113,0	57,5	84	53,7	139,0
n. of conference proceedings	5,1	29	3,3	7	11	52
Average ranking of academic institutions represented in the consortium	208,4	154	155,5	68,0	121,0	20
n. of patents and patent applications	0,0	0	0,0	0	0,0	0

n. of other IPRs	2,0	12,0	7,0	20,0	13,0	38
n. spin-offs or starts-ups created following the project development	0,6	2	0	0	0,2	1
	n. of projects who selected 5 or 6 (likert scale going from 1 to 6)					
n. of projects likely to open up and/or establish new types or fields of research	0		1		1	

Table 19: Competitiveness of research – cluster 2

Considering now "Innovativeness and transfer outside the domain", we can say that, again, we cannot recognise a linear relationship between projects performance and number of users engaged, even if projects with a higher number of users have better performances on six variables out of nine. In the table below we visualise the results obtained.

	Less than 100 users		Between 100 and 1000 users		More than 1000 users	
	Average	Maximum	Average	Maximum	Average	Maximum
n. of public events outside the domain (to a wider typologies of stakeholders)	2,3	9,0	1,5	3	7,3	20
n. of training materials	11,4	45	62,8	160	23,7	85
n. of training events	5,6	15	9,5	20,0	10,2	26
n. of trained persons	45,9	100	138,0	400,0	221,8	598
n. of industrial partners and SMEs inside the consortium	2,3	7,0	1,8	4	3,2	7
n. of collaboration agreements outside the e-Infrastructures domain	2,1	7,0	3,0	4	2,0	6
n. of knowledge repositories or instrument fostering collaboration and knowledge exchange for users	1,8	5,0	13,8	50	4,2	8
n. of dissemination activities and total audience	15,0	38,0	23,0	38,0	54,8	157
Total audience	1562,0	5215,0	11047,5	21040,0	74365,3	164.341
	n. of projects who selected 5 or 6 (likert scale going from 1 to 6)					
n. of projects likely to have outputs which lower entry barriers to economic markets for our users	0		1		2	

Table 20: Innovativeness and transfer outside the domain research – cluster 2

We will conclude the analysis of effectiveness by looking at the performance of this cluster of projects in terms of "cohesion". On this macro-variable it seems possible to trace a direct correlation between the number of users and the achievements. However the interpretation in not straight forwards: we can say that project with more users perform better in terms of cohesion of vice versa. We tend to prefer the latter interpretation in which projects with a good level of cohesion are also better able to reach a high number of users.

Having said that, we have also to mention that projects with less than 100 users perform - on average – better than the one in the middle group with a number of users that goes from 100 to 1000.

	Less than 100 users		Between 100 and 1000 users		More than 1000 users	
	Average	Maximum	Average	Maximum	Average	Maximum
n. of nations represented in the consortium	9,7	28,0	5,3	7,0	14,8	46
n. of partners from new EU members States	2,0	23,0	0,5	1,0	5,7	25
n. of partners from outside the EU	3,3	23,0	0,8	3,0	9,8	41
n. of agreements with actors outside the consortium representing countries outside the EU	0,8	4,0	1,8	4,0	6,3	29
n. of European countries covered by dissemination activities at national level	1,4	3,0	1,0	2,0	4,5	10
n. of dissemination activities with an audience at European level	10,0	27,0	9,0	10,0	34,8	121
n. of dissemination activities outside Europe	2,2	5,0	9,5	12,0	13,8	45
n. of women in research-related role	5,2	16,0	5,8	10,0	7,2	29
n. of young researchers	10,9	68,0	8,8	15,0	13,7	76
	n. of projects who selected 5 or 6 (likert scale going from 1 to 6)					
n. of projects likely to connect and provide exchange opportunities	1		1		1	

for users from different domains			
n. of projects likely to expand their range of services to audiences outside the research domain	1	2	1
n. of projects likely to expand the geographical range of their users and of their collaboration activities	4	2	2
n. of projects likely to allow for coordination of scattered community	2	1	2

Table 21: Cohesion for cluster 2

5 E-INFRASTRUCTURES AND E-INFRASTRUCTURE PROJECTS IMPACT ON ERA

The following paragraphs present the results of the fourth block of the ERINA+ methodology as well as the ERINA+ database aggregate analysis, aiming at understanding the impact of the e-Infrastructures and e-Infrastructure projects on the implementation of the ERA objectives.

We will describe the result of the Social Network Analysis (SNA) and some of the aggregated data analysis performed and visualised through the ERINA+ Dashboard.

In the previous chapter we saw how e-Infrastructure projects support researchers and their communities, foster competitiveness of research, promote the knowledge transfer from academia to industry and the training system and work towards cohesion.

The principal research question for block 4 was: to what extent are e-Infrastructures and related projects able to contribute to the creation of a research community speaking with one single voice? Which typology of actors, which national communities, which disciplinary communities can be considered as central? Do e-Infrastructures and related projects support collaboration between research actors and on-academic ones?

These research questions have been addressed thanks to the aggregated data analysis that we have already shown and the deployment of the social network analysis technique of which results will be described in the following paragraphs.

As we will see, the social network analysis technique was used to understand, describe and visualise:

- Relationships of projects with existing e-Infrastructures
- Synergies among on-going projects based on collaboration agreements
- Synergies among institutions generated by the participation to e-Infrastructure projects
- Centrality of various disciplinary communities
- Centrality of different categories of stakeholders (direct users and non-direct users)
- Impact that the use of an e-Infrastructure has in terms of enlargement of research networks from an inter-disciplinary point of view (more disciplinary communities engaged) and from a geographical point of view
- Typology of stakeholders engaged (type of organisation: public, private, etc.)
- Geographical distribution of e-Infrastructure project partners and centrality of various national communities
- Centrality of specific organisations and strength of the collaborations
- Targets of the dissemination activities as a channel for opening up the user base of e-Infrastructures

Not all the dimensions have been investigated with the same details and this is mainly due to data availability.

5.1 The e-Infrastructures community

We studied the e-Infrastructures community by analysing the 21 collaborating projects composed of 398 projects partners; representing in 61,56% of the cases old EU member states, in 14,32% of the cases new EU member states and in 24,12% of the cases partners from outside the EU (see Figure 30).

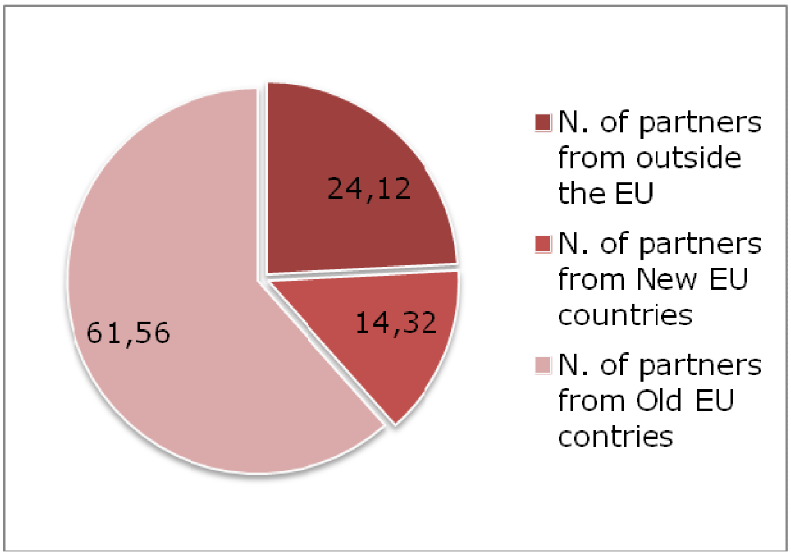


Figure 30: Countries represented in projects consortia

If we consider all the projects co-financed under the e-Infrastructures programme since 2004, we have 2.732 actors[6], distributed as follows: 65,26% from old EU Member States, 15,52% from new EU Member States and 22,22% from countries outside the EU.

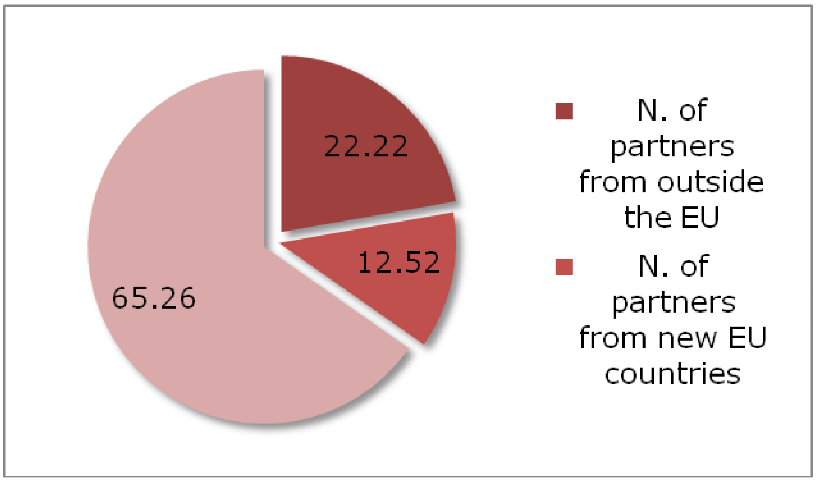


Figure 31 Countries represented in all the projects co-financed under the e-Infrastructures in the period 2004-2012

As evident, in the project financed in the last period (Fig.30) the percentage of partners from new member states increased, so did partners from outside the EU. This can be interpreted as a positive sign of a growing collaboration among researchers and research centres throughout the enlarged Europe and behind.

If we look now at the countries participation over the period 2004-2012 we see that there are some countries that are stable in their participation, and others, which participation is less stable and - generally – characterised by a more reduced number of participants (see

[6] Please note that we considered all the partners of each project, even if some actors participated in various projects. Therefore, some actors could be considered more than one time in this number.

Figure 32). More specifically, Italy, Germany, France and the UK are the countries that express the highest number of participants throughout the period analysed. Spain reaches the level of participation of the 4 mentioned countries in each of the years considered with the exception of 2004 and 2006. Sweden's participation grew constantly from 2004 to 2012 and is higher than the countries nearby: Finland and Norway. Greece's participation was generally high, and reached the top values in 2006, 2008, 2009, 2010 and 2011. The Netherlands shows top values in 2005 and then from 2007 until 2012. The participation of countries such as Romania, Bulgaria, Poland, former Yugoslavia countries, Baltic republics and Turkey is less strong, but they are always represented and in some years their participation grows. Russia belongs to the e-Infrastructures community since 2004 and reaches the top value in 2005. Of course, in analysing the maps we should keep in mind the country dimensions and the dimensions of its scientific community, so that the fact that Russia reaches the top value (10 to 27 organisations participating in the programme) has not the same value of a similar performance reached by, for example, Greece.

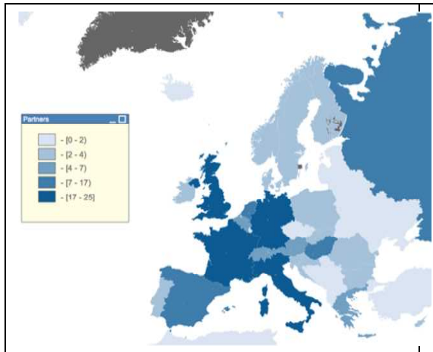
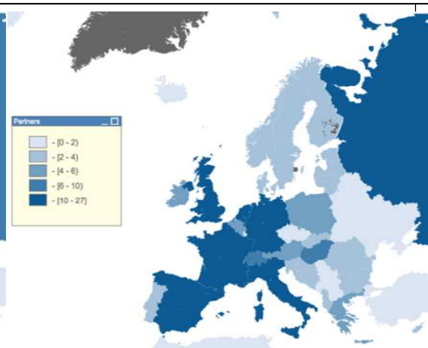
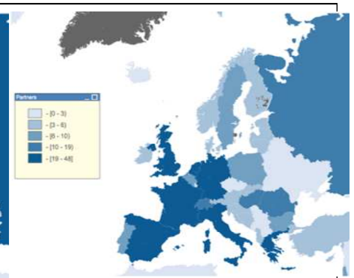
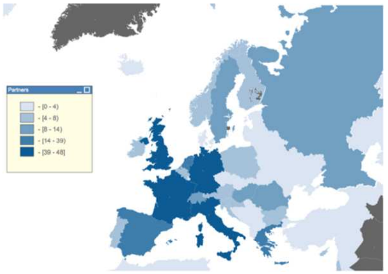
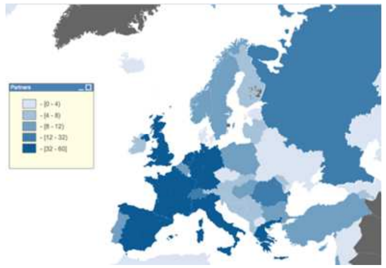
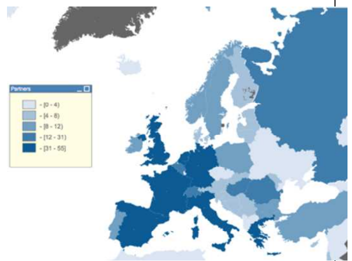
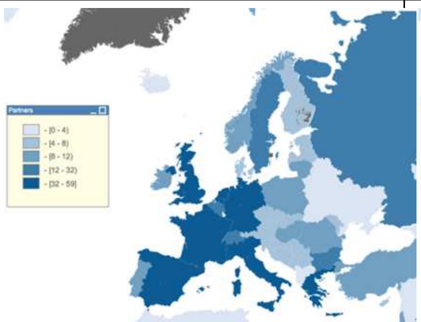
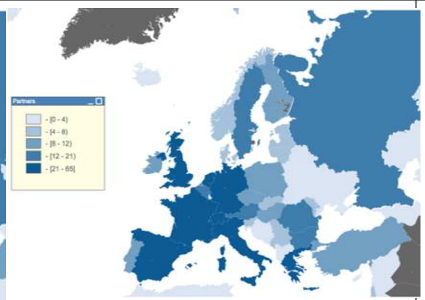
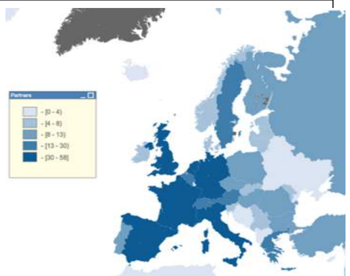
		
2004	2005	2006
		
2007	2008	2009
		
2010	2011	2012

Figure 32: Number of partners per country, years 2004-2012

With reference to the sample we analysed more closely (21 projects) we can see that 43% of the beneficiaries participating in the programme are secondary and higher education establishments, therefore mainly universities. About 30% of the participants are non-profit research organisations and 13% are enterprises.

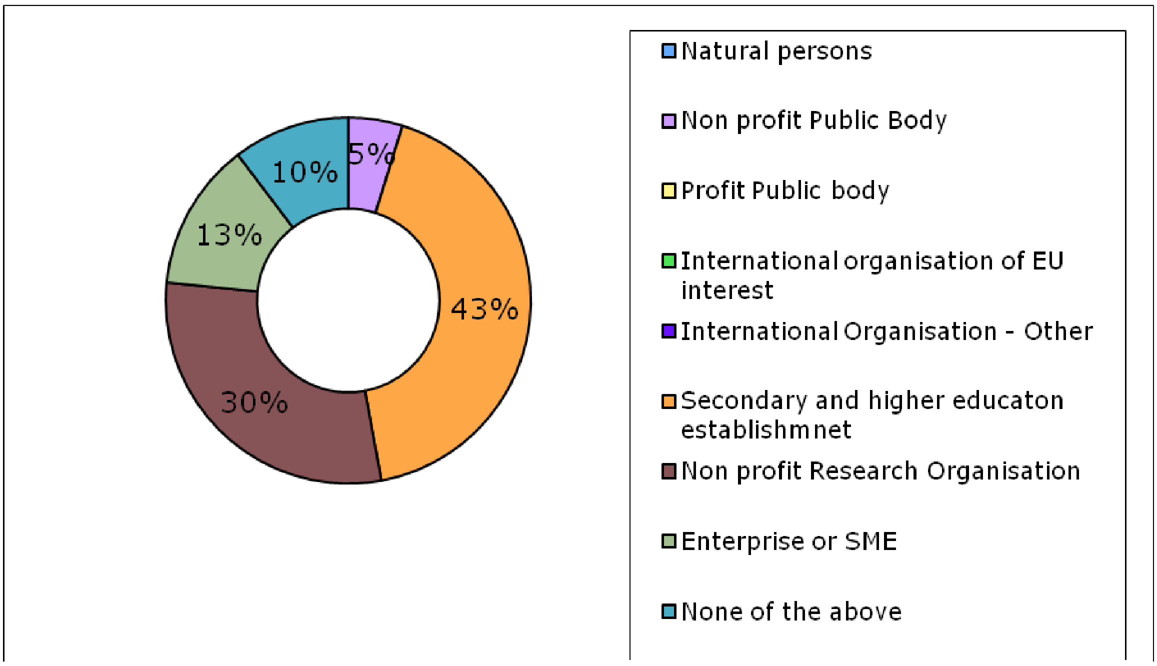


Figure 33 - Beneficiaries typologies in ERINA+ sample

If we now look at the totality of the projects funded in the e-Infrastructures programme from 2004 up to today, we can see that – even if the categories are not exactly the same due to difference in the original data bases – governmental bodies represent the majority and correspond, almost in the totality of cases to research centres and universities. Also the participation of the enterprises shows a similar proportion over the total number of participants.

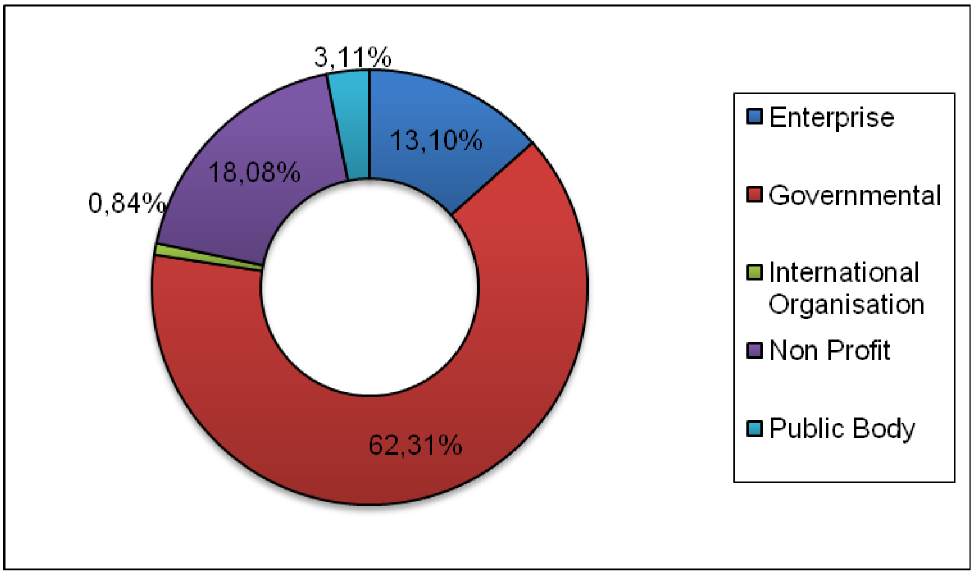


Figure 34 - - Beneficiaries typologies considering all the projects in the period 2004-2012

5.2 Projects values chains and predecessors

We asked collaborating projects to indicate if they have a temporal predecessor, meaning with this term a project, now closed, that created the basis for the project under analysis. Twelve projects answered positively to this question, indicating their temporal predecessor. The figure below shows the relationships between collaborating projects (in pale red) and their predecessors (in grey).

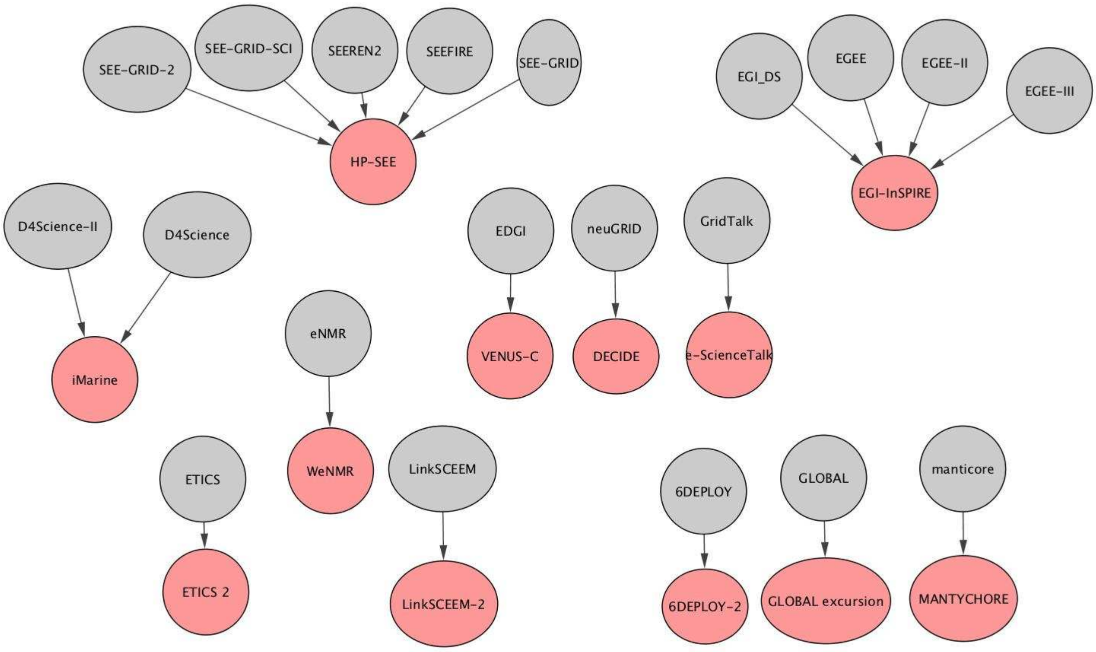


Figure 35: Temporal predecessors[7]

Most of the projects have only one predecessor, but there are three cases with more than one predecessor. This information is important because it makes explicit one of the complexity aspects of the e-Infrastructures domain. In order to evaluate the impact of a project, in fact, we should consider also its temporal predecessor and being able to evaluate and distinguish the impacts produced by the first project and by the followers. However, at the present stage this is not possible, because we only have data coming from the collaborating projects. Nevertheless, it is interesting to see that current projects do not share predecessors and that more than a half of the collaborating projects are built on previous experiences. For further improving the methodology, it would be interesting to ask the projects to self-assess the percentage of present outputs that are possible only thanks to the predecessor or, by using a case study approach, go deeper in analysing the role predecessor play in explaining the impacts of actual projects. It would be also interesting to know if projects with a predecessor show higher impacts if compared with project without a predecessor. This will give us the possibility to understand better after how many years since a first investment it is sensible to expect a certain level of efficiency and effectiveness. The ERINA+ methodology allow this kind of analysis, but the relatively small number of projects assessed refrain us to generalise such results in a general statement about expected impacts.

[7] The names of the projects assessed are not in anonymous form in this figure for two main reasons: firstly the information are generally publicly available through project website, secondly, by making the projects anonymous and by assigning them a number as in the following figures, they have been easily recognisable making the following figure no more anonymous.

5.3 Project stakeholders

This paragraph is dedicated to the analysis of project stakeholders. We asked collaborating projects to indicate their end-users and other typologies of stakeholders. We defined "end-users" as an entity that directly uses the service or the e-Infrastructure developed by the project under analysis and "other stakeholders" as actors, institutions and groups that may have an interest for project activities and outputs. In the graph below we can see the relationships between each project (in grey) and its stakeholders (in purple). Continuous lines indicate that the stakeholder is a "direct user", while the discontinuous line indicates that the stakeholder is of other nature. The ERINA+ team suggested the categories of stakeholders; respondents used all the categories (14) available.

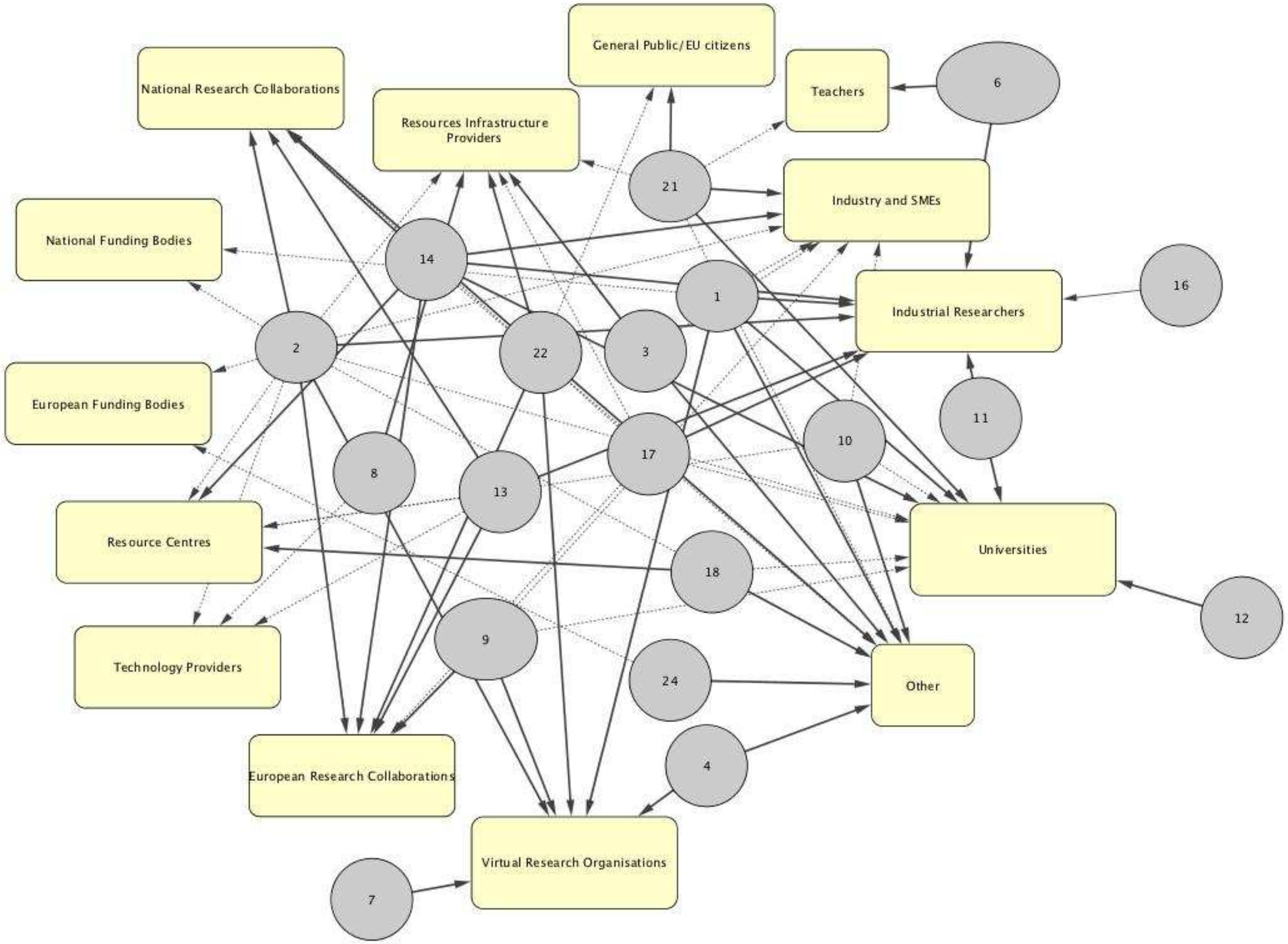


Figure 36: Projects' stakeholders

The most selected categories of end users are: universities, Virtual Research Communities (VRCs), EU research collaborations and Industrial researchers. Teachers, national funding bodies, EU funding bodies, General public and technology providers are the less represented as end users but also as in-direct beneficiaries. From the graph it is also possible to see that there are projects with only one or two categories of direct-users, while there are projects with up to 8 different typologies of end-users. The category "other" is relevant because 7 projects selected this option: the ERINA+ Webtool gives the possibility for describing the category. In most of the cases this indicates that direct users are other e-Infrastructure projects.

Looking at the same data using another visual representation, the weights of the singular categories can appear clearer. Therefore, in the figures below we show the end users first and then the other users.

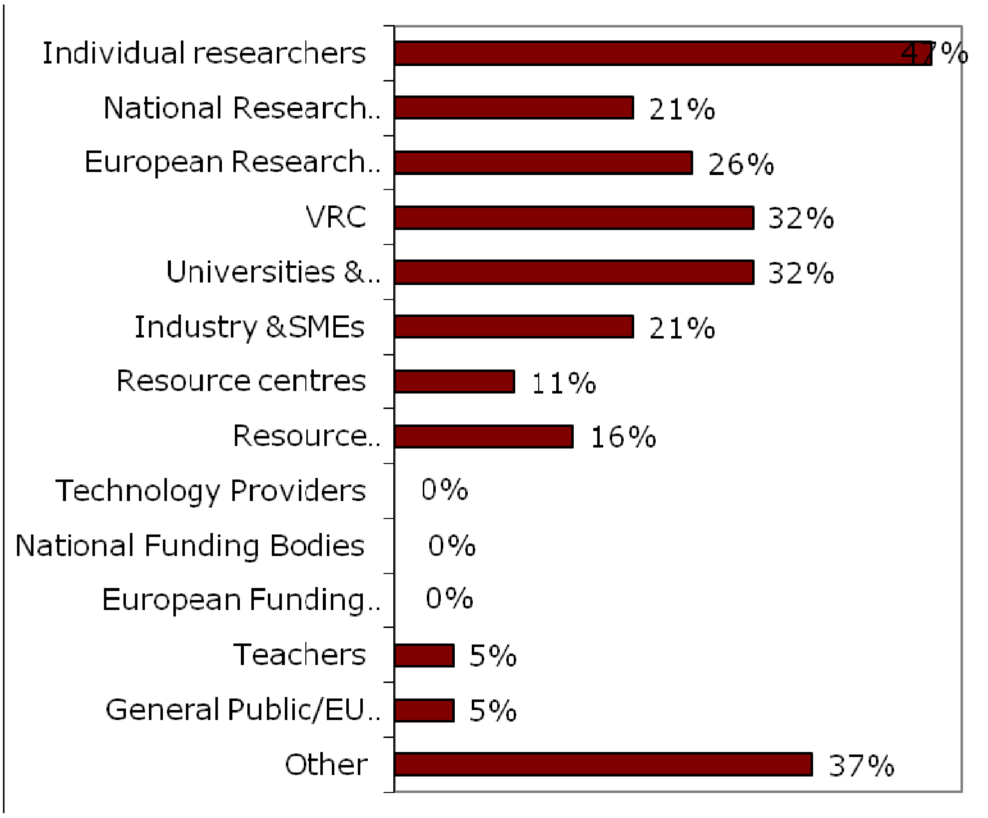


Figure 37: Categories of end-users

(* the sum is different from 100% because respondents could select more than one category)

Immediately after the category of "single researchers" (with 42% of the answers) we have the category "Other" that as we mentioned often represents "other e-Infrastructure projects". We will see in the following chapters that the collaboration among projects is quite high and this data confirms this result. Moreover, "other projects" we also find clinicians and hospital staff and, in one case, society at large.

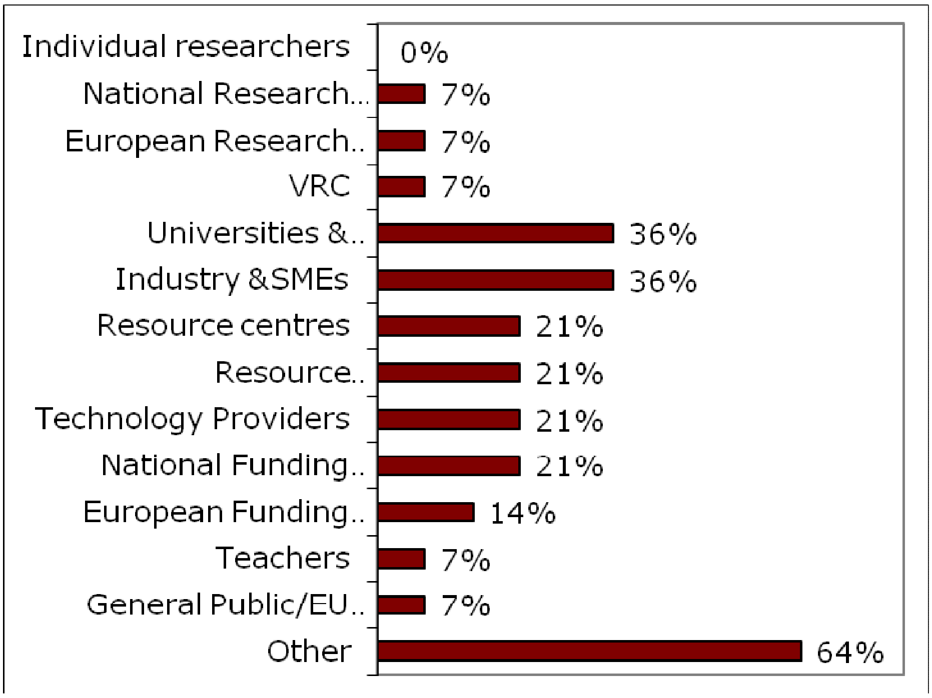


Figure 38: Categories for "other stakeholders"

Also in the category "other stakeholders" or non-direct users, we see that the category "Other" groups most of the answers (64%), universities and research centres and industry and SMEs are the second most common choice indicating an interest in bridging the research domain and the industrial sector in the 36% of the respondent.

5.4 Synergies among on-going projects based on collaboration (formal and informal agreements)

We also asked the collaborating projects to indicate projects with whom they collaborate. Two typologies of collaboration were possible: "cooperating with" and "support to". We defined "cooperating with" as a formal/informal agreement with another project in order to exchange information or to develop a common/complementary approach to achieve a common result(s), while we defined "Support to" when the collaborating project is a support/coordination action and provides support to other project(s). In the graph below we see, in pale red, projects that answered to our questionnaire, in grey projects they are collaborating with. Continuous line represent "cooperation" and dot lines represent "providing support".

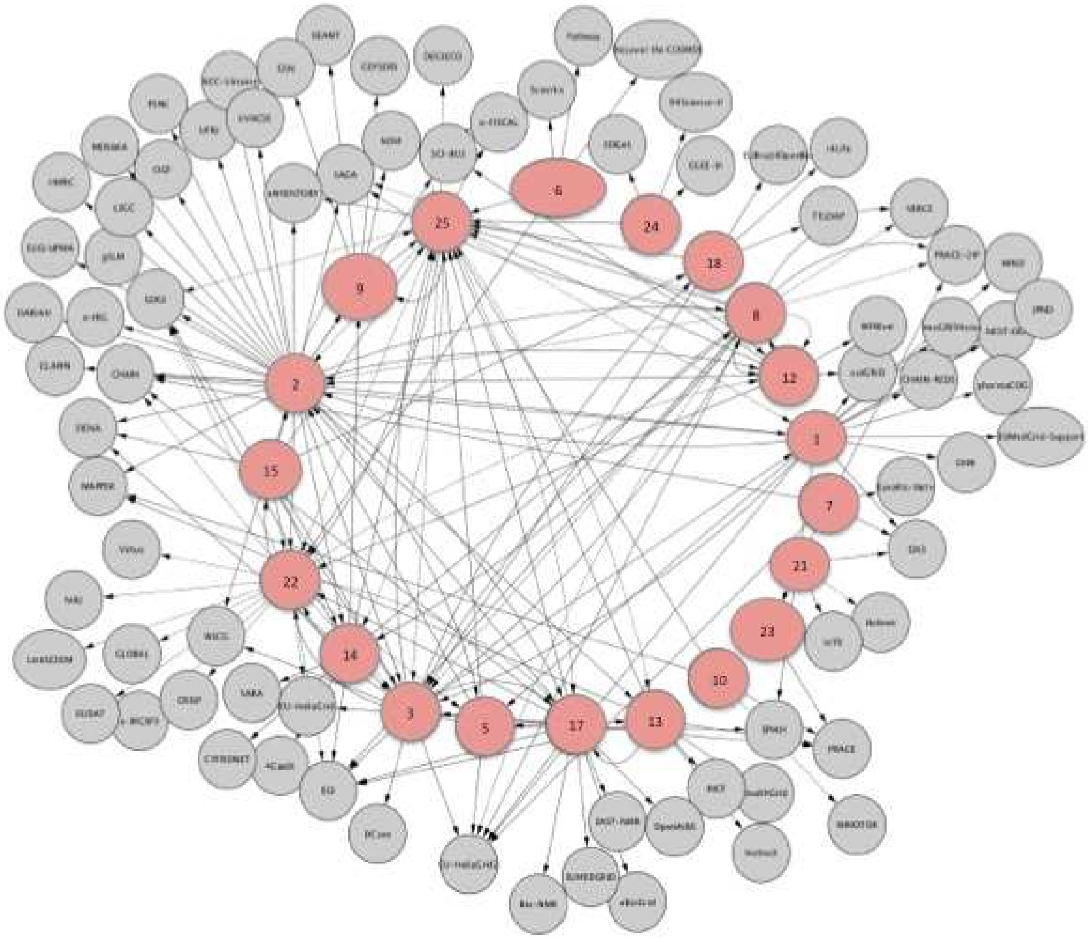


Figure 39: Collaboration among e-Infrastructures projects

There are several shared links (visible especially inside the circle) but also one to one interactions. Of course we cannot claim to have mapped all the synergies, because only 18 projects answered the related question, but we can observe a total number of 155 links and 97 nodes. This number is surely high, but if we look at the graphs we can see that the number of collaborations that each of the assessed projects established vary considerably. Support actions, as expected by their very nature, are among the ones that have more collaboration links. But it is remarkable that there are projects with very few collaboration links. The highest number of collaboration links is 30, while the lower one is 2; the average value is 8.2. More specifically, network density is 0,034 a value that we can consider quite low, in fact if all nodes would have been connected with all the other nodes the value would have been 1.

Looking again to the graph, it is clearly visible that there are projects that play a central role in the domain: these are the ones indicated by multiple arrows, the one selected by many projects are projects they collaborate with. We can observe one of these projects in the left side of the figure, in the middle; another one is in lower part of the picture, while on the top we have ERINA+ and on the lower-left part of the figure we can see another support action.

5.5 Synergies between project and e-Infrastructures

Another relationship investigated by the ERINA+ team is the one between projects and e-Infrastructures. We asked the projects to select three possible relationships defined as follows:

Contributing to: the e-Infrastructure(s) that the respondent project contributes in some way to: (1) review (2) improve (3) expand (4) standardize (5) optimize scalability and efficiency in one of its processes or functionalities

Reusing: the e-Infrastructure(s) which the respondent project uses its offered service(s): (1) hardware (2) software (3) middleware (4) algorithms (5) functionalities, etc.

Support for: the respondent project is a support/coordination action and provides support for a specific e-Infrastructure.

The ERINA+ team did not provide a list of e-Infrastructures among which the projects could answer; but once a project provided an answer the following one, taping one or two letter would see the suggestions the system provides by using the answered provided by the projects who answered before.

The first result is that – within the e-Infrastructures domain - there is not a shared definition of what is an e-Infrastructures. In fact, all the balloons in pale red represent the answer we got: the e-Infrastructures from the point of view of the respondent projects. If we take those answers literally, we should conclude that there are more than 50 e-Infrastructures.

What we were interested in was to see the value chain connecting projects to pre-existing e-Infrastructures. For this reason, we selected what we can define as main e-Infrastructures mentioned by respondent projects and coloured them in blue.

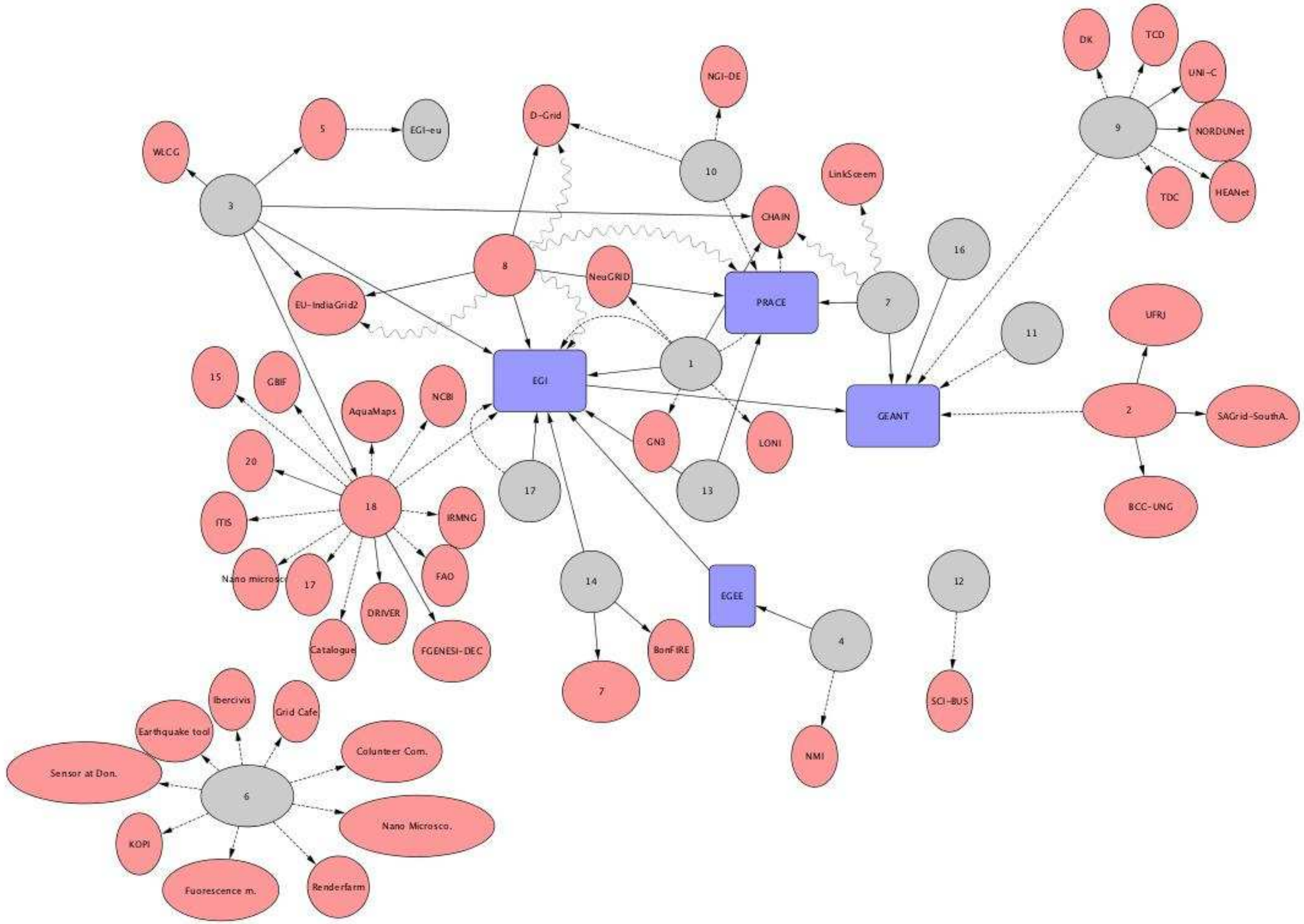


Figure 40: Relationship between projects and main e-Infrastructures

14 projects answered positively to the question under analysis; GEANT and EGI are the e-Infrastructures mentioned the most. Of course there is a link between the two initiatives, but is interesting to see that six projects mentioned EGI, five selected GEANT and no one selected them both. A more accurate, qualitative analysis would be needed in order to understand how to interpret these answers. In fact, is can be that those projects that selected EGI, are aware of its link with GEANT and give it, somehow, for granted. If this is the case we should add indirect connections to GENAT to those projects that selected EGI. In this way the network density will grow considerably and so will do the centrality of GEANT.

Looking at the different typologies of relationships we can see that 44 links (continuous line) express the relationship "reusing" that is the most common one, then we have 33 links for "contributing to" (dotted lines) and 13 links for "support" (wiggly line). In total, we have 90 collaborations, with an average value of 14 links per project. The total number of node is on 68 and the network density is equal to 0,033 so that we can define this network as a quite dispersed one. This is also evident by the existence of a separate network within the larger one, the one that aggregates around project number 6. By excluding project number 6 from the analysis the network loose 8 nodes, moreover, by excluding project number 18 the network will lose 12 nodes and so will loose EGI as an infrastructure. It would be interesting to apply the Social Network Analysis to a large sample f projects in order to better interpret the centrality of the various, mentioned, e-Infrastructures.

This network, if associated with the previous ones dedicated to project predecessors and to collaborations among project, is useful for visualising the value chain that connects different projects with underlining e-Infrastructures. Looking also at this graph, it would be interesting in better understanding (use a case-study approach) to describe more in details how projects number 17, 1 and 18 contribute to the development of EGI and to what extent EGI efficiency and effectiveness is due to the support of those projects. A similar analysis could be conducted for mapping the relations and the synergised among projects 9,11, 2 and GEANT.

5.6 Disciplines

If we now focus our attention to projects' users, it is possible to have an idea of the discipline they belong to. Looking at the disciplines represented by e-Infrastructure projects' users, we have to remember that one of the targets of the e-Infrastructures programme is that of enlarging its user base and opening the e-Infrastructures domain to disciplines other than the traditional ones. In order to see which are the disciplines represented in the domain, we asked projects users to define their discipline of belonging. The figure below shows the results gathered. One more time, it is important to remember that only a few projects succeeded in engaging their users so that the sample we are going to examine here cannot be considered exhaustive, neither statistically representative.

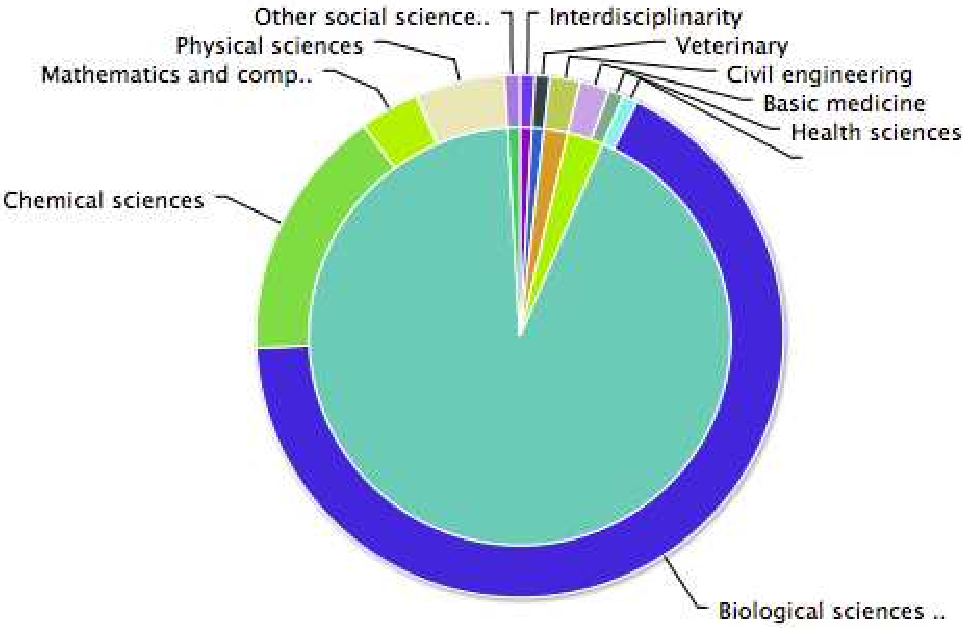


Figure 41 – Projects' users: discipline of belonging

The classification used for this analysis is that of the Frascati Manual (OECD, 2002) also used by the EC in its questionnaire/format for the final report (in the FP7). The figure above shows, in the internal circle, the macro disciplines represented by the users, i.e. natural science in pale green represent the waste majority of the users. In the external circle we find more detailed discipline labels such as biological sciences, chemical science, mathematical and computer science and physical science. As said, the majority of users belong to the natural sciences domain; within this domain, the most numerous community is that of biological sciences, followed by chemical sciences, physical sciences and mathematics and computer sciences. More specifically, looking at the sub disciplines mentioned we find an important community of biochemistry, biophysics and structural biology.

The users do not represent social science and humanities disciplinary domains, while there are very few (less than 5) representatives of engineering and technology, medical sciences and agricultural studies.

Projects, moreover, tend to serve one or very few disciplinary communities, in fact, only three projects said that they are likely or very likely to connect and provide exchange opportunities for users from different domains. Of course the concept of "different domains" could be interpreted in different ways but, still, the attention of the projects seems to be more on "connect a scattered community" than "to create new field of research and connect different domains".

As we mentioned in D6.1 engaging with e-Infrastructure users belonging to disciplines other than natural sciences in not an easy task; it requires the development of ad hoc services on one hand, and appropriated interfaces[8] on the other. More effort should be invested in order to achieve this objective, and also for supporting researchers in developing inter-disciplinary activities. In this respect, the ERINA+ team slightly

[8] Interphases are here intended both in technological and socio-cultural terms.

changes the user data gathering instrument in order to allow the respondent to better describe their research activity when interdisciplinary.

5.7 Bridging to other domain: dissemination target audiences

Looking at the interest and effort in bridging different domains, an important objective of the ERA is that of linking the research domain with the training system on one hand and with the private sector to the other hand. We asked collaborating projects to indicate the main targets of their dissemination activities (see also paragraph 4.2.2) in order to see if this objective is also of interest for the collaborating projects.

Not surprisingly, the scientific community represents the first target of the dissemination activities. Users are the second most important targets (and to a certain extent users are also part of the scientific community), while students are targeted only by three projects (one of which is a support action). Policy makers, industrial sector and civic society are targeted by four projects, while media have been mentioned by two projects. More effort in including students as central target should be made by e-Infrastructure projects, because engaging them can result in enlarging the user base and in creating a fruitful link between the training systems and the research domains.

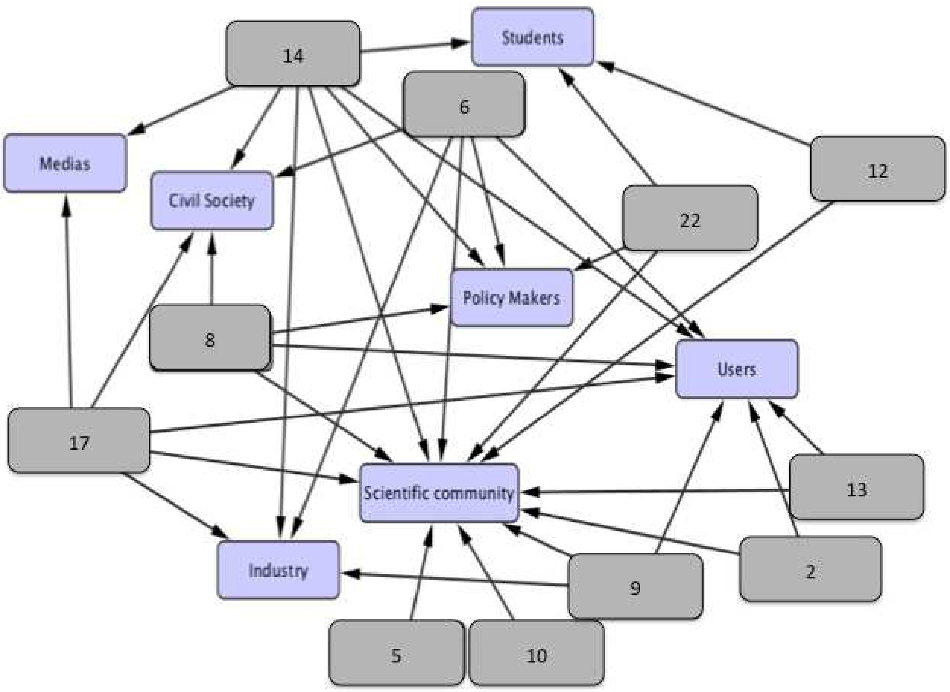


Figure 42: Dissemination audiences

5.8 Impact on ERA objectives

Looking at the impacts of e-Infrastructures on ERA goals, finally, implies to consider competitiveness and excellence of research, innovativeness and transfer outside the domain and cohesion dimensions that have been already analysed in the previous chapter[9].

We will try now to see how this research can be linked to the components of ERA policy.

The components we will consider are the following:

- Component 1- Knowledge Activities: Volume and Quality
  "The ERA defines the European way to excellence in research and is a major driver of EU competitiveness in a globalised world"
- Component 2 - Knowledge Triangle: Flows and dynamics
  "Strong interactions within the "knowledge triangle" (education, research and innovation) are promoted at all levels"
- Component 3 - Fifth freedom: intra and extra-EU openness and circulation
  "The ERA provides a seamless area of freedom and opportunities for dialogue, exchange and interaction, open to the world"
- Component 4 - The Societal Dimension
  "The ERA is firmly rooted in society and responsive to its needs and ambitions"
- Component 5 – Sustainable development and Grand challenges
  "The ERA is firmly rooted in society in pursuit a sustainable development"

With reference to component 1 we have seen the aggregated results of the e-Infrastructure projects in terms of "Competitiveness of research". We also saw what scientific results of project users developed thanks to e-Infrastructure projects outputs. We do not have enough data for assessing the whole domain, but from the sample we have evaluated and also considering what the project reported enclosed in D3.3 "Lesson Learned" we can see that - even if the main focus of e-Infrastructures domain is to support researchers in being more competitive at world level, never the less projects in the domain contribute to the advancement of research by delivering peer-review articles (with and without an impact factor) and by supporting their users in doing so.

Component two is covered by the macro index "Competitiveness and transfer outside the domain". The aggregated analysis shows that an important effort has been given in disseminating project results also outside the e-Infrastructure domain, but how we have seen in this chapter the research sector is the most important one for this domain, while more effort can be invested in linking this domain with education and innovation. We can say that the instrument of the support action can be the most appropriate for linking – as it is already observable – the e-Infrastructure domain with the media, the training system and the citizens.

In regards to component 3, e-Infrastructures can be seen as virtual environments in which researchers and their outputs can freely move from one country to another. In this sense we have seen the growth of the participation of new EU countries and important collaboration with countries outside the EU. Specific projects were dedicated to enlarging the collaboration networks of the e-Infrastructures domain, but – aside from this – we can observe a general high interest in connecting research from different countries.

It was somehow difficult to frame the impact of e-Infrastructures on society as a whole, as citizens are not central stakeholders of the e-Infrastructure projects and society will receive indirect benefit by the support e-Infrastructures are providing to researchers all around the world. Thanks to the "Cohesion" index we investigated to what extent e-

[9] In D2.1 those impacts where attributed mainly to block 4, but they are now the pillars of the entire ERINA+ methodology. All the blocks contribute, consequently, to provide data and analysis in this direction.

Infrastructure projects are contributing to the integration of women in science and we can observe that there is room for improvement. Also the fact that gathering workflow statistics on a gender base which was difficult for some projects, can be – at least partially – interpreted as a difficulty in considering gender mainstreaming as a key asset of the future of the EU. Furthermore, we also collected data about the integration of youth in research, here the results show that a new generation of e-Infrastructure experts is growing. Besides this, we are aware of specific projects that may have a significant impact at a social level: one, for example, is working in the health sector and the support it is providing to doctors and researchers in the field can really contribute to a higher quality of life for European citizens.

The fifth component recalls the role of e-Infrastructures in society but also their economic and financial dimensions which have been already analysed in chapter 4. It is worth mentioning the support the domain can contribute in creating new and better job places in the research sector, definitely a strategic one for the future of Europe. More on this component can be found in D6.1 and D6.2 which addresses social and economic challenges Europe is facing and the contribution of e-Infrastructures and are built on a stakeholders perception analysis and interviews with key informants.

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