

e-IRG White Paper 2013

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Final short version

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Management summary

Research and innovation are key elements of the EU's 2020 strategy for European competitiveness in the world.

In today's world, the services provided by the *e-Infrastructures for Research* are essential for progress in any type of research. Such e-Infrastructures include high-performance and high-throughput computing, high-end storage, advanced networking, middleware services such as authentication and authorisation, and services to support research workflows.

While e-Infrastructure services are available in all European countries, the available resources and the conditions for access to these services vary strongly. These e-Infrastructures are organised by country, and often by type of resource. However, modern research is international by nature, and requires integrated services and interoperable infrastructures across Europe and the world.

The e-IRG Roadmap 2012 therefore outlines a need for a European "e-Infrastructure Commons" for knowledge, innovation and science in order to meet the challenges of implementing the EU's 2020 Strategy.

To implement such an e-Infrastructure Commons, a high degree of collaboration and standardisation is required. Furthermore, to provide users with leading edge services, a constant innovation at all levels is necessary. A certain degree of competition helps to ensure high quality of services and effective service provision.

As a living ecosystem, an e-Infrastructure Commons must be flexible and able to change dynamically, efficiently, and in a future-proof manner. e-Infrastructures for research will only provide real value if they can provide services which are way ahead of what commercial providers can offer.

In order to achieve all this, an ecosystem of different organisations is needed, both at the national and international levels, each with their own focus but also with effective coordination between them.

A heavy involvement is needed from the user communities, ensuring alignment between user needs and the development of the e-Infrastructures. User communities must be empowered to fulfil this role, through a strong say in strategy and service delivery. A logical step towards such a model is to funnel the funding for operational services through the users.

At the same time, users will not want to spend their limited budgets on innovation of the underlying infrastructure, as long as their specific needs are being met. The innovation of the e-Infrastructure therefore needs direct and on-going funding.

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1. Introduction

Research and innovation are key elements of the EU's 2020 strategy¹ for European competitiveness in the world. By strengthening the entire chain from fundamental research to practical product innovation, Europe intends to stimulate the development of new products and services, which will lead to economic growth.

An important enabler for research and innovation is the availability of e-Infrastructure services. Such e-Infrastructure services include:

- Access to high-performance computing (supercomputing) and high-throughput computing (including grid computing);
- Access to high end storage for ever increasingly large data sets;
- Advanced networking services to connect computing and storage resources to users and instruments;
- Middleware components to enable the seamless use of the above services, including authentication and authorisation;
- Generic services for research, providing support for research workflows using combinations of the above (sometimes called *virtual laboratories* or *virtual research environments*).

Most of these e-Infrastructure services are already available, in some form, in every country in Europe. However, the available resources (in terms of functionality and capacity) vary strongly between countries, limiting the possibilities for international collaboration. There are also different conditions for access in each country (and sometimes for each type of e-Infrastructure service), often restricting the ability of universities and research institutes to involve commercial researchers in their work.

These differences between countries are natural, as e-Infrastructures are organised by country, and often even by type of resource. However, modern research is international by nature, and requires integrated services and interoperable infrastructures across Europe and the world.

To meet the challenges of implementing the 2020 Strategy, Europe needs an "e-Infrastructure Commons²" for knowledge, science and innovation that is open and accessible, continuously adapting to the changing requirements of research and to new technological opportunities.

The need for an e-Infrastructure Commons in Europe is further outlined in the e-IRG Roadmap 2012³. This White Paper takes the discussion one step further, by exploring the current situation and the existing barriers, and proposing a number of steps to resolve these barriers.

Contributions for this White Paper were produced by various e-IRG champions, all experts in different areas. In order to keep the White Paper sufficiently concise, the original contributions have been strongly condensed. However the originals, as well as the comments received during the consultation round, will remain available through the e-IRG website⁴.

¹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:fin:en:pdf>

² Commons: Resources accessible to all members of a community

³ http://www.e-irg.eu/images/stories/publ/e-irg_roadmap_2012-final.pdf

⁴ <http://www.e-irg.eu/publications/white-papers.html>

2. The objective: integrated services via interoperable e-Infrastructures

Users, researchers and research communities in Europe all need high-quality e-Infrastructure services that are well-managed and above all seamlessly integrated from a users' point of view, so that they can get on with their business of science instead of spending effort on the various requirements to access those services. With the increasing importance of international research collaboration, IT intensive research, and the use of Big Data, this need is becoming more urgent.

e-Infrastructures and Big Data

Big Data is widely perceived to be one of the most challenging items to be addressed in the coming years.

Big Data challenges the constraints of current e-Infrastructures in terms of volume, variety and velocity of data.

The e-IRG 2012 roadmap foresees, for the evolution of the current e-Infrastructure towards Horizon 2020, a common data infrastructure integrating a set of coherent data services exposed to users by means of an interoperable set of underlying e-Infrastructures.

This Collaborative Data Infrastructure is a key element to let user communities get on with the business of science, while the generic data services they need are provided by various actors.

To cope with emerging Big Data, new tools and methods are being developed. Hadoop is such an example. Hadoop is a framework, specifically designed for dealing with data intensive problems; it provides the necessary tools for several Big Data methods such as association rule learning, cluster analysis, pattern recognition, predictive modelling, and others.

Other relevant tools for Big Data analysis are NoSQL data stores. These allow for data to be partitioned across different machines, as there is no need to follow a fixed relational schema. This approach provides better scalability and resilience to failures, compared to relational database systems.

Users and e-Infrastructure service providers should work together in order to create and improve such type of tools.

Beside the technical challenges involved in creating a collaborative data infrastructure, several legal and ethical issues need to be resolved. An important area is privacy: Big Data, which includes data about individuals, will need extra safeguards. Anonymising the data is now standard procedure, but with the ability to combine datasets from different sources there is a significant risk that data can still be traced back to the original data subject.

However, such an integration of services requires the full interoperability of the underlying e-Infrastructures. The current Internet demonstrates this principle: there is a common user interface and access mechanism, to functionally common services, provided by a huge variety of physical networks and network management domains. The end result is an integrated end-to-end service from the user point of view, created through interoperable physical networks. The user does not notice the variety of underlying networks and organisations.

The challenge now is to provide this type of user experience for the full set of e-Infrastructure components in Europe and worldwide.

Such an e-Infrastructure Commons will require a joint and truly common strategic effort between the user communities and the organizations involved in the development and operation of e-Infrastructures, both at the national and at the European level.

3. Barriers and limitations

There is already an extensive ecosystem of e-Infrastructures in Europe. Most countries have advanced networks for research and education, facilities for high performance computing, high throughput computing, and storage, and various initiatives to provide middleware, tooling, and expertise for the research environment.

However, these e-Infrastructures and the organisations managing them have evolved along different functional, geographic, and type-of-user dimensions. As a result, there are often separate organisations for computing, networking, and other e-Infrastructure services, sometimes with very different funding and governance models.

At the European level, many stakeholders may find it difficult to navigate in the present landscape of policy-making for e-Infrastructures, as there are several advisory bodies and projects aimed at policy development. Clearly today, there is insufficient cohesion among the different actors to address the challenges ahead.

There is also relatively little involvement of the user and user communities in shaping the e-Infrastructure landscape and its innovation, in particular at the European level.

Hence, many of the barriers towards realising European e-Infrastructures Commons 2020 are structural and organizational, rather than technical.

Institutional and geographic borders are increasingly artificial in the “virtual” world of e-Infrastructures. Existing procedures and regulations are not necessarily those best suited for 2020. Organisational models, business models, governance structures, funding models, and regulatory landscapes all face fundamental challenges in the context of an evolving European e-Infrastructure Commons.

Recent publications from several stakeholders show a growing common understanding of the issues involved and ways forward, notably the GÉANT Expert Group report, EGI2020, the PRACE Roadmap, the EUDAT Roadmap, the Riding the Wave report, as well as the recent e-IRG Strategy report and the e-IRG Roadmap 2012.

Some of the issues the stakeholders are currently facing are:

- Insufficient coordination and integration of existing e-Infrastructures services;
- Legal issues, created by disparate legal frameworks in different countries (see text box);
- Limitations on the use of e-Infrastructures by commercial researchers;
- Lack of “Visibility” of e-Infrastructure services, but high awareness by users of borders, interfaces, and technologies of the individual components;
- Lack of sustainable funding streams for the use and innovation of e-Infrastructures;
- Limited integration with commercial service providers;
- The lack of coherence from the user communities, beyond a few well-organized examples such as CERN and EMBL-EBI.

Working with commercial research - potential legal barriers

Existing state-funded e-Infrastructures are mostly used by state-funded researchers in universities and other academic research institutions. Allowing commercial research and development to make use of these e-Infrastructures could have significant benefits, but in many cases uncertainty about the rules and formalities at national and European levels is discouraging this.

Allowing commercial organizations to use state-funded e-Infrastructures may constitute State Aid. While European State Aid rules allow for contributions to commercial R&D, the formalities required can be perceived as a barrier. The European Commission is working on a revised block exemption, which should simplify these formalities.

European Procurement law requires the purpose of the procurement to be specified. Therefore, e-Infrastructure providers considering use by commercial research should take this aspect into account in future procurement documents. They should also review the risks of market parties challenging any change of purpose regarding earlier procurements.

Also, many e-Infrastructure providers (in particular NRENs) are owned and controlled by the institutes for higher education and research. European procurement law allows these institutes to order services from such an e-Infrastructure provider without a need for a European tender, but only as long as the provider gets "an essential part" of its business from the owning institutes. There is currently no hard number to specify how much this "essential part" has to be, but it is usually assumed to be at least 80% of the business. The proposed new Procurement Directive sets the limit at 90%. Therefore, if commercial parties account for more than 10% of a provider's business, the owners may be forced to follow European tender procedures in order to acquire services from their own e-Infrastructure provider.

According to the Telecommunications Framework Directive, National Research and Educations Networks are providers of Electronic Communications Services. However, in most cases they are not public providers. To avoid such a status, and the obligations that go with it, they should only provide services to sufficiently demarcated groups of users. This can include commercial research, as long as the demarcation is clear.

Where e-Infrastructures are used to process personal data that use will be subject to Data Protection law. If e-Infrastructures cross national borders, the applicable rules may be unclear, as national implementations of the European Directive differ and sometimes even contradict each other. Providers of e-Infrastructure services should consider the use of approaches such as Privacy by Design and Privacy Enhancing Technologies to reduce risks.

Other areas in which barriers to commercial users exist are the current terms of use of the e-Infrastructure providers and the terms of relevant software licenses.

Providers of e-Infrastructure services should review their terms of use to enable participation by commercial research; international coordination bodies should strive for international harmonization of at least the basic rules permitting access.

Providers of e-Infrastructure services should identify the licences they have and whether there are any that do not permit commercial use. Where bespoke software is being developed, rights to the intellectual property should be agreed before development starts, preferably through open licensing.

A more detailed analysis of these issues is available on the e-IRG website (<http://www.e-irg.eu/publications/white-papers.html>).

There is a significant difference in terms of requirements between flagship user communities, such as the ESFRI-projects and the EIROFORUM-labs, and the 'long tail' of individual scientists or smaller research collaborations. The European e-Infrastructures need to support this variety of users.

Data Policy for Large-Scale Research Projects

Research infrastructures, such as the initiatives on the ESFRI roadmap, produce and are dependent on rapidly increasing amounts of data. For research and society to take full benefit of the major investments in research infrastructures the data needs to be made openly and easily available for researchers, over wide spans of fields, in sustainable settings. To enable this, the data needs to be managed, stored and preserved in a cost-efficient way, with appropriate quality and safety assurances. Also, access to the data across borders and domain boundaries must be secured.

e-Infrastructures provide the versatile services and tools needed for both data management and access, but the development of such infrastructure must be complemented with new policies on the side of the research infrastructures.

In 2012, e-IRG presented a Blue Paper, on this topic with a focus on the needs of large research infrastructures such as the ESFRI Roadmap initiatives. Besides improvements in governance and funding structure, the Blue Paper recommends that users and e-Infrastructure providers should work together on standardised data and metadata formats. It suggests that e-Infrastructures should be built in multiple layers, adding more specialised services on top of generic services, so that users can select the appropriate services. The generic service level should include authentication and authorisation services and persistent data identifiers, supporting a next level of common data storage services serving a wide set of research infrastructure users.

Several actions directed towards integration of e-Infrastructure services are already ongoing, including activities in areas such as Authentication & Authorisation, Persistent Data Identifiers, and Service Registry & Discovery. The development of user support functions, such as the PRACE Competency Centres, also helps promote the uptake of e-Infrastructures. However, clearly more must be done to support the end-users.

4. Proposed approach

No single e-Infrastructure provider currently provides a full portfolio of e-Infrastructure services needed by the end users. However, users want a single and easy to use interface to all e-Infrastructure services they need. They need services that are coherent, managed and above all integrated so that they can get on with the business of science. They also need a constant innovation of these services, way ahead of what commercial providers can offer. Therefore, we need to ensure interoperability without stifling innovation.

A centrally managed e-Infrastructure is not a solution. The idea that there will be just “one way” of supplying a service through an “efficient” monopoly (even a “voluntary” monopoly) has to be avoided. Allowing and encouraging e-Infrastructures to evolve is important: open competition, collaboration, but also technological bypassing and new distribution concepts of service belong to the 2020 vision as well.

An e-Infrastructure Commons can only be established through a joint and truly common strategic effort between users and primary strategic actors and suppliers. However, striving for a common strategic vision should not become a barrier to continuing innovation and ambition of each of the individual (existing) services.

In the 2020 vision, providers have the freedom to innovate, and users enjoy the freedom to choose the services they need from a mix of public e-Infrastructure and commercial

services. In order to enable this vision, we need an ecosystem of different organisations, at the national and international levels, each with their own focus but also with effective coordination between them.

e-IRG believes this challenge can be met by maintaining a clear separation between the three core functions:

1. **Community building, high-level strategy and coordination in Europe:** for each type of e-Infrastructure service, a single coordinating organisation with a central role for user communities. These bodies, in turn, will need a forum for coordination between them across the different e-Infrastructure types.
2. **Service provision:** flexible, open, and competitive approach to national, European, and global service provision; with advanced collaboration among the interested public and commercial service providers.
3. **Innovation:** Implementation of major innovation projects through the best consortia including e-Infrastructure suppliers, industry, users and academia with a dedicated management structure comprising the partners per project.

As shown in the GEG report⁵, such a separation is essential in order to create a flexible and effective ecosystem.

e-Infrastructure services from the Cloud

Cloud computing is often mentioned as a major factor for economic boost, lowering IT costs and bringing new income to IT vendors and IT service providers, while at the same time leaving room for innovation for all parties involved. Despite all this positive publicity, it is not yet clear if the cloud is the solution for scientific computing and storage of scientific data.

The “cloud” is not a separate infrastructure, but a range of services, which can be implemented on existing e-Infrastructures. Different flavors of cloud services (IaaS, PaaS, SaaS, etc.) build on different layers of the infrastructure - for instance on the hardware layer, the platform, or the applications.

Most e-Infrastructure services can be offered in the form of cloud services. However, it is often difficult to determine whether this model actually saves costs, due to the differences in business model, capabilities, and service levels. Also, funding models for research are often not suitable for the use of cloud services.

Lack of standardization and concerns about security, jurisdiction and vendor lock-in also inhibit the take-up of cloud services.

National and European e-Infrastructure providers should work together to create transparent, integrated cloud-based services for their users, allowing for economies of scale across Europe. Where possible, these services should combine the capabilities of their e-Infrastructures with those of commercial services.

Funding agencies should address the limitations of current funding models, by channeling funding through the end-users and allowing these users to make rational decisions between investing in infrastructure and acquiring cloud services.

⁵ “Knowledge without Borders”, report of the GÉANT Expert Group, 2011
<http://cordis.europa.eu/fp7/ict/e-infrastructure/docs/geg-report.pdf>

To implement such a model, users need to become much more directly involved in strategy, coordination and innovation in each of the e-Infrastructure components. This implies that users also need to be empowered to drive the direction of e-Infrastructure services. To this end, the funding for service delivery should be channelled through the users, rather than directly to the service delivery organisations. Only then will users be able to select the best possible providers, including commercial providers.

Not only will this help reduce costs for the researchers, but it will also encourage service delivery organisations to provide the best possible service at the lowest possible cost level, and stimulate the use of public and private cloud services (see text box). It will also stimulate commercial providers to match the services created through the e-Infrastructure, leading to a faster dissemination of these concepts to the broader market.

For this approach to work, it is essential that the position of user communities in e-Infrastructure governance is strengthened on four levels:

1. On the **strategic** level user communities will have to organise themselves to drive the long-term strategy.
2. On the **service provision** level user communities will have to learn to use their joint purchasing power, in a competitive market, which includes both public and commercial offerings.
3. On the **innovation** level advanced users of international e-Infrastructures should participate in the specification and real-life testing of new e-Infrastructure developments. LHC and eVLBI are already good examples of this approach.
4. On the **standardisation** level user communities should contribute to the process of setting and implementing the international standards necessary to achieve the international, service-oriented, interoperable e-Infrastructure portfolio envisioned for the e-Infrastructure Commons 2020.

The e-IRG sees a clear need for a single e-Infrastructure umbrella forum for community building, high-level strategy setting and coordination for the entire e-Infrastructure. This umbrella forum is not a separate organisation, but a forum in which the user communities and the strategy and coordination bodies for the different parts of the European e-Infrastructure work on a common strategy.

Such a forum can also address common issues like:

- Increasing the visibility of e-Infrastructures;
- Making e-Infrastructures relevant to a wider user base (better & more broadly appealing services);
- Investigating how to resolve the existing Digital (e-Infrastructure) Divide;
- Eliminating legal and political roadblocks for international harmonisation of exploitation and innovation of e-Infrastructures;
- Promoting the use of sustainable business models for e-Infrastructures, in support of exploitation and for innovation of international e-Infrastructures;
- Promoting effective structures for international governance and finance giving users of all sizes a suitable role: from large pan-European ESFRIs to smaller international research collaborations;
- Enabling standardisation in order to ensure seamless delivery of end-to-end services across multiple domains and multiple resource types;

- Enabling the development of uniform, federated authentication and authorisation mechanisms in support of Open Science (see text box).

e-IRG is a clear candidate to facilitate this umbrella forum, and has already expressed its willingness to do so.

5. Recommendations

International user communities requiring e-Infrastructure services should organize themselves to be able to address the challenges in their future roles:

- Driving the long term strategy for their e-Infrastructure needs;
- Using their purchasing power to stimulate the development of suitable, effective e-Infrastructure services;
- Participating in the innovation of e-Infrastructure services;
- Contributing to standards.

International organizations of e-Infrastructures should join forces and share their common challenges towards serving the European user communities, thereby avoiding duplication of efforts (as far as possible) in such areas as:

- Outreach to and involvement of user communities;
- Services registry, discovery and provisioning;
- Financial, legal, business development and procurement issues

Support for Open Science

Open Science includes Open Access (freely available results) and Open Data (access to the underlying data), but also Open Research, the sharing of research methods and software.

Open Science is seen as a huge step forward in making research results more reproducible, gaining transparency, and easing collaboration on existing research data.

Although the major challenge for Open Science is the change in scientific culture, e-Infrastructures are fundamental instruments for Open Science.

European e-Infrastructures should contribute to Open Science through uniform authentication and authorisation mechanisms, persistent data storage services, and improved discovery processes. This will require new funding models, lasting beyond the lifetimes of individual projects.

Research organisations (in particular those running large research infrastructures) should provide data archives, and open them for use by a wider community. They should also ensure that data and metadata formats are standardised, in order to enable global use within the discipline, across disciplines, and even in completely new research settings.

These organisations should establish a clear separation between responsibilities for strategy setting and community building, operations, and innovation. Working with the user communities, they should strive to establish the e-Infrastructure umbrella forum for strategy setting in Europe, with sufficient user participation for community building, high-level strategy and coordination for the entire e-Infrastructure, with -again- a clear separation from operational responsibilities.

National governments should:

- Provide a basic funding level for their national e-Infrastructure, in particular devoted to its continuous innovation;

- Empower and fund their national user communities for the use of e-Infrastructure services, enabling them to influence the development of the national e-Infrastructure;
- Remove existing national regulatory or political constraints for accessing publicly funded e-Infrastructures for private research and public-private research ventures;
- Provide input for the strategy setting and coordination bodies for their national e-Infrastructures;
- Encourage the actors in their national e-Infrastructures to collaborate and join forces with their counterparts in other countries and at EU level, along the lines described above.

The EU should strengthen the actions of the national governments by:

- Establishing a European harmonised framework for the funding of e-Infrastructure innovation;
- Encouraging a sustainable e-Infrastructure offering in Europe through innovation programs such as Horizon 2020, using conditions designed to encourage multiple innovation efforts by different consortia;
- Empowering and funding European user communities, such as the ESFRI projects, to influence the development and use of transnational access to the e-Infrastructure;
- Enabling and promoting the use of Structural Funds for e-Infrastructure development in less favoured areas;
- Providing input for the European strategy setting and coordination bodies and their umbrella forum;
- Striving towards harmonisation so that regulatory conflicts can be avoided, both at the national and at the international level, with existing regulations for (among others) state aid or competition rules;
- Providing clear guidelines for ‘regulation proof’ participation of private research in the use of e-Infrastructure services.

Existing e-Infrastructure Service Providers will have to face the continuous challenge of service development and operation, funded through public schemes in the early and precompetitive phases, and through user fees thereafter.

Annex I - Glossary

CERN	European Organization for Nuclear Research (originally the Conseil Européen pour la Recherche Nucléaire)
Commons	a resource management principle by which a resource is shared within a community (refer to “Infrastructure: The Social Value of Shared Resources”, 2012, B. Frischmann)
e-Infrastructure	an environment to share research and educational resources (e.g. network, computers, storage, software, data) so that these resources can easily be accessed and used by academia, researchers and scientists as required
e-IRG	e-Infrastructure Reflection Group, the European international advisory group for e-Infrastructure related policy makers
EIROFORUM	a partnership between eight of Europe’s largest inter-governmental scientific research organisations that are responsible for infrastructures and laboratories: CERN, EFDA-JET, EMBL, ESA, ESO, ESRF, European XFEL and ILL. (http://www.eiroforum.org/)
EMBL-EBI	European Molecular Biology Laboratory - European Bioinformatics Institute
ESFRI	European Strategy Forum on Research Infrastructures (http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri)
GÉANT network	The pan-European research and education network ⁶ (originally: Gigabit European Academic Network)

⁶ The term GÉANT can be used in different meanings, as in: “GÉANT network” for the pan-European network backbone, “GÉANT project” for the GN3+ project and its predecessors, and “GÉANT2020”, as used by the GEG for a GEANT2020 European Communications Commons.

Annex II - For further reading

- *A strategy for smart, sustainable and inclusive growth*, Communication from the European Commission, COM(2010) 2020:
<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:fin:en:pdf>
- *Riding the wave - How Europe can gain from the rising tide of scientific data*, (2010):
<http://cordis.europa.eu/fp7/ict/e-infrastructure/docs/hlg-sdi-report.pdf>
- *A Surfboard for Riding the wave. Towards a four country action programme on research data*, M. van der Graaf and L. Waaijers, A Knowledge Exchange Report (2011):
<http://www.knowledge-exchange.info/surfboard>
- *Knowledge without Borders - GÉANT 2020 as the European Communications Commons*, GÉANT Expert Group (2011): <http://cordis.europa.eu/fp7/ict/e-infrastructure/docs/geg-report.pdf>
- *A Reinforced European Research Area Partnership for Excellence and Growth*, Communication from the European Commission COM(2012) 392:
http://ec.europa.eu/euraxess/pdf/research_policies/era-communication_en.pdf
- *Infrastructure: The Social Value of Shared Resources*, Brett M. Frischmann (2012)
- *e-IRG Roadmap 2012*: http://www.e-irg.eu/images/stories/publ/e-irg_roadmap_2012-final.pdf
- *Cloud Computing for research and science: a holistic overview, policy, and recommendations*, e-IRG taskforce (2012):
http://www.e-irg.eu/images/stories/dissemination/e-irg_cloud_computing_paper_v.final.pdf
- *e-IRG “Blue Paper” on Data Management*, (2012):
http://www.e-irg.eu/images/stories/dissemination/e-irg-blue_paper_on_data_management_v_final.pdf
- *Scientific data: open access to research results will boost Europe's innovation capacity*, European Commission (2012): http://europa.eu/rapid/press-release_IP-12-790_en.htm
- e-IRG White Papers (including the input papers and comments for this White Paper):
<http://www.e-irg.eu/publications/white-papers.html>
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Annex III - Editorial Responsibilities

Introduction:

Jan Wiebelitz

Theme 1, e-Infrastructure Commons 2020: Integrated Services via interoperable e-Infrastructures

Champion: The Netherlands, Editors: Arjen van Rijn, Kees Neggers

Contributor: Frank van Iersel

Theme 2, Open Science

Champions: Germany and France, Editors: Gabriele von Voigt, Anne Decrouchelle

Contributors: Françoise Genova, Lambert Heller, Jan Wiebelitz

Theme 3, Policy Requirements for ESFRI Projects

Champion: Poland and Sweden, Editors: Norbert Meyer, Sverker Holmgren

Contributors: Gelsomina Pappalardo, Bjørn Henrichsen, Lorenza Saracco

Theme 4, Big Data

Champions: Italy and Greece, Editors: Luciano Gaido, Panos Agyrakis

Contributors: Jan Wiebelitz, Paschalis Korosoglou, Minos Garofalakis

Theme 5, Cloud Computing

Champion: Belgium, Editor: Rosette Vandenbroucke

Contributors: Maciej Brzezniak, Radek Januszewski, Fotis Karagiannis, Dana Petcu, Marcin Plociennik, Imre Szeberenyi, Paweł Wolniewicz

Theme 6, Legal Barriers to Commercial Use of e-Infrastructures

Champion: England, Editors: Andrew Cormack, Bob Day

Contributors: Paul Lewis, Sandra Oudejans, Willemijn Waisvisz, Eirini Kontrafoura, Nikolaus Forgó, David Foster, Panos Louridas