Why invest in e-Infrastructure for R&D?

E-Infrastructure refers to ICT infrastructures for research and innovation covering networks, data centres, computing, e-government services and the broader public sector. It has strong spill-over effects for the overall economy as it is both a stand-alone sector and an enabling infrastructure for other sectors. Investments in e-Infrastructures support growth within and through the ICT sector, and create possibilities for fostering innovation in other sectors. ICT tools and infrastructures ("e-Infrastructures") have transformed research, development and innovation (RDI):

- Research increasingly takes place through collaboration in large research teams that span several organisations and countries. This means that researchers need high speed telecom connections to collaborate online.

- RDI relies on computers and software for modelling, simulation and analysis. Almost no RDI is possible today – from the design of a car part to the prediction of weather – without access to proper computing resources.

- "Big data" is the new fuel of research and innovation. This means that data must be preserved and made discoverable, accessible and re-usable. This requires deploying a data infrastructure within organisations as well as at national or regional level.

- ICT expertise is in short supply but is necessary to support the above three requirements. Supplying the appropriate skills is an integral part of the e-Infrastructure.

Access to state-of-the-art e-Infrastructure is necessary for all players of the RDI ecosystem: Universities, research centres and laboratories where academic researchers work; companies designing products and services; national or regional computing and data centres and research libraries supplying services to researchers and innovators; and public authorities and research agencies that need to monitor RDI investments.

Today no country or region can be competitive in RDI without an advanced e-Infrastructure: high-capacity and high-performance communication networks, computing services, scientific application software, data repositories, computational expertise and a system that encourages collaboration and sharing of information. E-Infrastructures are also often used beyond research, for example in education or public services, e.g. to provide hospitals and public libraries with ICT tools and high-speed connections.

Therefore, regions wishing to invest in RDI should consider the strategic role e-Infrastructures play for advancing towards the EU 2020 objectives of smart, sustainable and inclusive growth. By investing in e-Infrastructures, regions empower their researchers and innovators to remain or become important RDI players. Where in the past motorways were a crucial infrastructural requisite for a region to become competitive, the deployment of e-Infrastructures today connects a region to the European and global “knowledge highways”, enabling scientific excellence and innovation for its scientists, engineers and companies. In this context, the EU’s Structural and Investment Funds should not only be used to set-up new infrastructures, but also to upgrade and maintain existing ones.

The new cutting-edge WIGNER Data Centre in Budapest, funded by the Hungarian government through the Research and Technology Investment Fund, is an extension of the CERN Tier-0 data centre in Geneva. As one of the first beneficiaries of the EU-funded GEANT ultra-fast multiple 100Gbps network, the WIGNER e-Infrastructure facility of 500 servers, 20,000 computing cores and 5.5 Petabytes of storage provides the necessary resources for the storage, distribution and analysis of around 30 Petabytes of data generated by the Large Hardon Collider61 in CERN. The capacity of the centre will gradually ramp-up following the needs of the LHC. The additional benefits of the Data Centre will help the Wigner Research Centre to become a focal point of advanced technology and know-how and a highly influential player in the area of international knowledge sharing and distribution.

Barriers & challenges

ICT infrastructures play a strategic role as a crucial asset underpinning European research and innovation policies.62 However, European regions vary considerably in their e-Infrastructure development and use. Their capacity to turn knowledge and skills into sustainable competitive advantage may therefore be limited by sub-optimal e-Infrastructure.63 Typical bottlenecks are: (a) missing or not well-developed national/regional multi-annual plans (roadmaps) for budgeting and the prioritisation of investments in research infrastructures, including e-Infrastructures; (b) lack of appropriate national financial instruments for the development, operation and upgrade of e-Infrastructures; (c) lack of awareness of the national managing authorities of the strategic role of e-Infrastructures and their contribution to sustainable regional development, economic growth and

63 In the programming for ESIF, ICT-based research infrastructures have been supported with the aim to bridge the digital divide especially between new and old Member States. Measures included e.g. the deployment of fibre optic cables for public usage in libraries, hospitals, schools and universities.
attraction of scientists and engineers; (d) weak involvement of regional representatives in cohesion policy actions (in particular in the identification of priorities regarding regional e-Infrastructures); and (e) insufficient knowledge exchange and engagement between research communities and regional institutions and authorities. E-Infrastructure investment may be necessary to support the RDI priorities identified in a RIS3, or the priorities of a digital growth chapter within the RIS3.

How to act?

1. **Analysis:** Regions wishing to invest in e-Infrastructures as part of a RIS3 may want to consider the following actions:

   a. Analyse the country/region's e-Infrastructure development by including all its core components (i.e. Research and Education Network Networking infrastructure, computing infrastructure (grids/clouds/supercomputers), data infrastructures, potential users, skills and investments) at local/campus, regional and/or national level. As baseline for the analysis the set of benchmarking indicators proposed by the European e-Infrastructure Observatory could be used or any other set of meaningful, measurable, and quick and easy to produce indicators, which allow to capture the key aspects of e-Infrastructure like capacity, costs and utilisation;

   b. Work with local partners to identify and assess challenges and needs for the development of new or upgrades of existing e-Infrastructures to be addressed by the region/country, including prioritisation and possible means of intervention;

   c. Determine the availability of skills and the national/regional needs for development of human capital in areas where new skills and professions will be needed, e.g. data-intensive research, computational sciences or e-Infrastructure operations.

   d. Estimate the costs and investigate potential sources of funding, including through PPPs;

2. **Governance/stakeholder involvement:** Public regional and local authorities should engage with relevant stakeholders. These actors will vary depending on the available potential in a region, but may include:

   - Public sector, such as national/regional ministries in charge of education, research, ICT, competitiveness, SMEs etc.; regional development organisations; and local government.

   - Research organisations, universities, libraries, museums, documentation centres and research archives.

   - National/regional research and education network operators, computing and data centres, and Internet providers.

   - Industry active in technology development and innovation, including SMEs.

3. **Priority setting:** Stakeholders should jointly agree on priorities in this area. When deciding what e-Infrastructure investments they will need to support within their RIS3 priorities, Member States and regions should consider the following objectives:

   a. Availability of rich computational infrastructures and services (HPC, clouds, grids, simulation software and tools) which are adapted to regional needs and future aspirations. Computing facilities may either be physically located in the region (e.g. if the region or Member State wants to specialise in IT or become a computation hub) or be made accessible remotely;

   b. Data access, storage, discovery, integration, curation and analytics; this may be driven by thematic needs, e.g. if the region aspires to be an innovation hub for marine biology then it needs to ensure a role on the international stage in managing the corresponding data;

   c. Development and operation of the research and education network at campus, local and regional levels, and its connection to the pan-European network GÉANT;

   d. Interoperability of the above infrastructures at European and global level;

   e. Availability of an authentication and authorisation system for access to services that is interoperable at EU level and facilitates mobility of researchers;

   f. Availability of the corresponding skills in academia and industry.

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64 The dynamic technological development and the need for increasingly advanced services for instance for e-Science, e-Infrastructures require continuous replacement and update. Funding should be targeted at the deployment of new e-Infrastructures (supercomputers, cloud infrastructure, high-speed connectivity, data repositories, etc.) and updating existing ones. The setting-up of a national roadmap for research infrastructures is recommended, such as the Strategic Vision for UK e-Infrastructures from 2011.

The Digital Agenda Toolbox

The Digital Agenda Toolbox

NREN - Hungarian National Research and Education Network66 - In the last decade, the Hungarian NREN has made a giant leap forward thanks to the financial support of the EU. The recent development is an important move forwards for the mutual benefit of both Hungary and Europe at large. The National Information Infrastructure Development Institute (NIIFI) develops and operates the Hungarian NREN and as such it has been part of the EU-funded high-speed research network GÉANT since 2000. The EU has been supporting GÉANT through its Research Framework Programme with EUR 93 million for the period 2009-2013. Part of this funding ensures the connectivity to GÉANT, which is linked to 10 regional networks across the world, reaching some 86 million users worldwide. It drives regional co-operation across the EU and strengthens European research as a whole. Until recently the optical segments of the infrastructure were dominantly based on leased lambdas. Since 2011, the new optical backbone, HBONE+, is working on some 3,000 km fibre network. For the renewal of the Hungarian NREN backbone and two other e-Infrastructure projects, NIIFI is receiving ca. EUR 18 million funding from the Structural and Investment Funds, through the Second National Development Plan. The budget of NIIFI for academic and research networking within the Hungarnet community in 2010 has been EUR 6 million.

4. Policy mix: With respect to RDI funding in general, precondition for success is the synergy of regional/local funding with other sources of funding both at the national and at the EU level. Besides improving efficiency in the use of available resources, this is important to ensure infrastructures which scale from regional to EU level. Note that strengthening European research infrastructures, including e-Infrastructures, is one of the specific objectives of the “Excellent Science” part of Horizon 2020 which fosters excellence of European research and innovation. Practical information about funding opportunities will be contained in the Work Programme of Horizon 2020. Unlike the current period, a single e-Infrastructure project (initiative) may receive support from ESIF and Horizon 2020. In addition, inter-regional networks such as TERENA are useful for sharing knowledge and promoting the development of ICT infrastructures and services for research and education communities.

The Czech multi-regional Operational Programme “Research and Development for Innovation”67 has allocated almost 70% of the total funding (EUR 2 billion) to European Centres of Excellence and Regional R&D centres and new RI. A new national Centre of Excellence in IT (IT4Innovations)68 has been built in Brno (South-East region) and in Ostrava (Moravia-Silesia region) with a Structural Fund contribution of EUR 66 million. Part of the project is the acquisition of a high-performance supercomputer that is planned to be put into operation in 2014, when it is supposed to rank among the top 100 most powerful supercomputers in the world. The centre will employ about 200 highly qualified researchers. Specialists from other parts of the Czech Republic and the whole world will be recruited throughout the entire period of the centre’s start-up.

5. Monitoring and evaluation: A RIS3 needs to include a monitoring and review system with quantifiable targets. Therefore, e-Infrastructure investments therein need to also have clear metrics, e.g. in terms of the capacity of the communication network, the number of users, the capacity of computing systems, the volume of research data that are made available, the number of user authentications per month, research data traffic within and in/out of the country (normalised by GDP), the installed computing capacity, the bandwidth-length (Gps-km) of the research network, the number of institutes/universities that have clear data policies and others.

Further reading
http://s3platform.jrc.ec.europa.eu/einfrastructures-for-innovation

