CESAER

The strong and united voice of universities of science and technology in Europe

UNIVERSITIES OF S&T AS ENGINES OF EXCELLENCE, TALENT AND INNOVATION

ROLES IN RESEARCH AND INNOVATION INFRASTRUCTURES

WHITE PAPER

Our Task Force Research & Innovation Infrastructures has been crucial in the writing and finalisation of this white paper. We thank the following writers of this paper in particular:

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LEUVEN, 13th March 2019

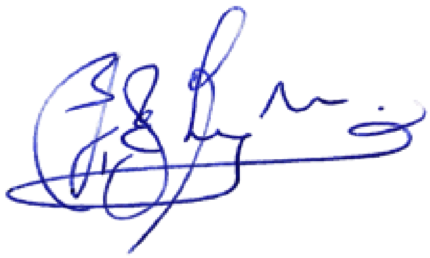
LETTER FROM THE VICE PRESIDENT

The roles of universities in research and innovation infrastructures generally are not well acknowledged in national and European policies and processes and their essential and tremendous contributions are often hidden behind perceptions of universities as mere ´users´. Even stronger, the current political debate on the long-term sustainability of research and innovation infrastructures threatens to marginalise universities through oversimplified focus and emphasis on service-orientation and key performance indicators for (large-scale and pan-European) facilities as independent legal entities and service-providers.

That is why the leading doctorate-granting universities united within CESAER - the strong and united voice of universities of science and technology in Europe - have joined forces to provide insights into their true roles and contributions. With this white paper, we demonstrate the importance of research and innovation infrastructures for the research, education, training, innovation and impact of our institutions. We describe how we (co-)operate and (co-)own significant small-, mid- and large-scale infrastructures. We testify being partners to many regional, pan-European, international and global facilities. Our researchers and research groups are at the forefront of the scientific case of literally all infrastructures: as users, frontier (lead) scientists, designers, reviewers, advisors, managers and governors. It is us who educate, train and deliver key scientific, managerial, operational and support staff for all kinds of facilities. We are the employers of these researchers involved in all phases of their lifecycles.

This white paper builds upon our continuous efforts and work in this field such as our Statement on the 'Long-term sustainability of research infrastructures' dated 9th December 2016, our Statement on the 'Shaping of the European Open Science Cloud' dated 24th January 2018 and our Statement on 'Innovation Infrastructures' dated 29th March 2018. We thus terminate this paper with conclusions and recommendations for policy-making and funding. We herewith underline our commitment to the realisation of the European Research Area and to safeguarding the long-term sustainability of research and innovation infrastructures and offer our expertise, efforts as partner.

On behalf of the Presidency, I thank those Members which offered their expertise, experience, best practices and efforts within our Task Force Research & Innovation Infrastructures. We are particularly grateful to the writers of this white paper for their elaborate work.



Karel Luyben
Vice President for Research of CESAER
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EXECUTIVE SUMMARY

The overall aim of this white paper is to promote a fundamental and conceptual understanding of the roles of universities of Science and Technology (S&T) in Research and Innovation Infrastructures (RII) and the importance of RII to those universities. It provides a concrete overview of the role of universities as engines of excellence, talent and innovation, based on case studies of universities across Europe, describing their roles as owners, hosts, contract partners, operators, funders and users of RII. Finally, we offer recommendations for policies and funding to safeguard the Long-Term Sustainability (LTS) of RII.

We set the scene beginning with the creation of the European Strategy Forum for Research Infrastructures (ESFRI) at the turn of the millennium and subsequent national road-mapping exercises. From 2006 onwards, much progress has been made through the development of national RII roadmaps and the support from the European Union (EU) framework programmes for research and innovation. However, it remains clear that the roles of universities in RII are not well recognised in the national and European contexts. The reason seems that we are still to make the transition from a linear vision of research and innovation to an ecosystem based approach acknowledging the crucial roles of universities for RII and of RII for universities in advancing research and innovation alike. To illustrate this transition in paradigm, we favour the term 'Research and Innovation Infrastructures' above of 'Research Infrastructures'. Importantly, the vast majority of RII are not pan-European, but local and national facilities that are highly dependent on university structures. A range of examples is provided in the Technical Annex. We propose that national and European policies and funding instruments clearly take this fact into account in the development of RII roadmaps and in the next generation of EU funding instruments from 2021 to 2027.

Our cases cover RII at the international, national and institutional levels and demonstrate that universities provide significant resources to establish and operate RII enabling multidisciplinary research collaboration, knowledge accumulation and disruptive innovation. Thus, universities and other Research Performing Organisations (RPO) have complementary roles to the ones from RII. While RII are means to achieve scientific and technological goals, universities are the main users of RII and major drivers for research and innovation (policy agenda-setting). A fundamental differentiation thus is needed between the quality of services provided by RII and the quality of the research undertaken through use of RII.

Universities of S&T encounter diverse challenges regarding RII, such as ensuring scientific excellence and breakthrough, making strategic choices, effectuating prioritisation, professionalising management, communicating and engaging with key actors, training, retaining and attracting talent and keeping up with diverse political and legal constraints. The response of universities of S&T has been unequivocal, contributing resources to maintain and update RII they host and operate and developing their own strategic decision making and priority setting processes in the form of institutional roadmaps. Through them, universities closely engage with stakeholders at all levels and advance the planning and development of RII along all phases of their lifecycles. We urgently need to overcome the perception of universities as mere users, when in fact they are the engines of excellence, talent and innovation enabling the functioning of RII at all levels.

The above are important pre-conditions for LTS RI, as described in the European Commission's (EC) staff working document 'Sustainable European Research Infrastructures: A call for action'. Matching the seven elements of this action plan LTS RI, we recommend to:

1. Ensure scientific excellence and breakthrough by acknowledging the role of universities in, and promoting professionalised management of RII and excellence based access. This should be done through the application of the European Charter for Access to Research Infrastructures and the detailed development, monitoring and evaluation of business cases and business plans. In this respect, we emphasise the need to make access costs to RII eligible in research and innovation grants.
2. Develop a Sectoral Qualifications Framework (SQF) for RII staff and ensure staff mobility across borders is facilitated alongside that of researchers.
3. Maximise impact by promoting the use of RII, supported by multidisciplinary and multi-background teams, through collaborative approaches between universities, other RPO and Research and Technology Organisations (RTO), business and industry, public services and society at large, e.g. under the European Innovation Council (EIC).
4. Develop a common, reliable and normalised reference framework for impact assessment, i.e. a common and minimal set of Key Performance Indicators (KPI) linked to mission and monitoring of RII.
5. Exploit data adequately by engaging universities in identifying the needs related to providing of e-infrastructures and e-services - namely in the context of the European Open Science Cloud (EOSC) - as well as develop science-driven research data management policies, in full consideration of thematic diversity.
6. Provide stable framework conditions for the governance and funding of RII by adopting long-term vision and funding commitment and clarify which funding instruments cover what (sorts of) costs in what phase of the RII lifecycle.
7. Reach out and open up to the world by engaging relevant stakeholders when developing (national) RII roadmaps. We advise governments at all levels to adopt public engagement strategies. We advise ESFRI to seek concrete and relevant collaborations outside the EU.

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1. SETTING THE SCENE

In chapter 1, the scene for the role of universities of S&T in RII is set. The national and European contexts are described and definitions provided.

1.1 NATIONAL CONTEXT

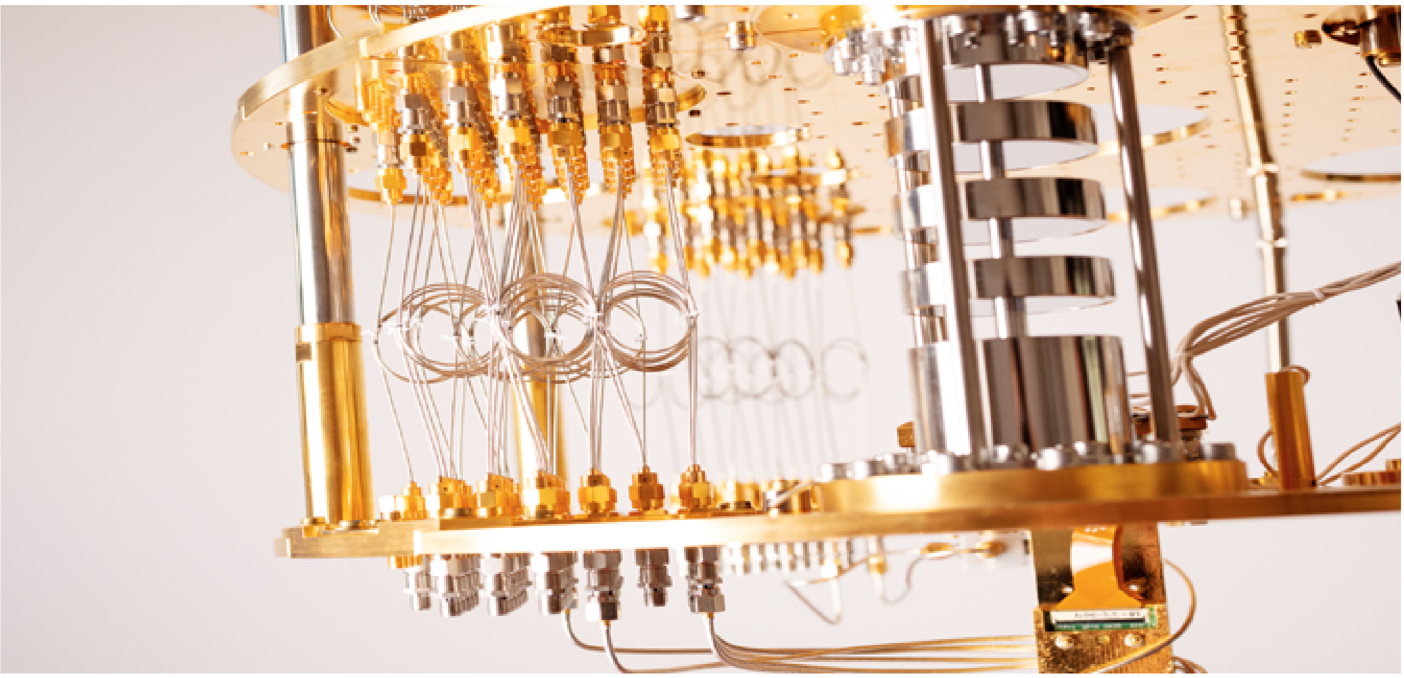
RII in Europe were perceived as being part of national research and innovation systems. The duplication of efforts, lack of critical mass and high costs for the construction, operation, maintenance and upgrade of RII revealed that the coordination between the regional, national and European levels was essential. Twenty five countries in Europe (twenty-two EU member states plus Montenegro, Norway and Switzerland) have to date developed and published national RII roadmaps aiming at identifying scientific needs and gaps within their country and setting priorities for funding. National RII roadmaps thus have become important tools for better coordination and coherence of the RII landscape and funding from different stakeholders.

However, inclusion of RII in national RII roadmaps does not guarantee funding, as the level at which strategic priorities are set and funding decisions are taken is different ranging from institu-tional, regional to national. The degree of centralisation in the definition of priorities and the coor-dination of funding decisions varies largely across systems. In most countries, national RII roadmaps are developed by ministries of education and research or national research councils. In others, no specific body is tasked with the management and oversight of RII (e.g. Ireland and Switzerland). Other institutions like universities there assume such responsibilities.

Moreover, the InRoad consultation revealed that only a limited number of national RII roadmaps are used to link and coordinate priorities and funding decisions between the institutional, regional, national and European levels. This supports the Council conclusions from 2014 to further coordi-nate country specific and European RII roadmaps and national funding decisions. In fact, collabo-ration at European level often results from the initiative of individual researchers who - through their research - participate in European projects and integrate platforms, networks and pan-European RII making available the facilities and skills at their research unit, faculty or department and to the wider scientific community.

1.2 EUROPEAN CONTEXT

The EC attributed important roles to RII in addressing the challenges our societies face today by bringing together researchers from different scientific fields and locations, with the goal of achiev-ing scientific breakthroughs, technology advancement and knowledge transfer. Facing megatrends such as climate change, resources depletion and exponential growth of data, RII are to become ever more relevant in the next decades.



QuTech Research and Development in Quantum Technology, Delft University of Technology
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The creation of the European Research Area (ERA) in 2000 aimed at improving coordination and collaboration in research and innovation. The importance of RII as part of ERA was acknowledged with the creation of the ESFRI in 2002. ESFRI delivered its first roadmap of pan-European RII in 2006 and updates thereof in 2008, 2010, 2016 and 2018. Developing and updating such roadmaps of pan-European RII required increased coordination between countries and invest-ments at various levels.

The diversity of national and regional research and innovation systems, different funding models, as well as the different approaches to RII (which in many cases was seen as mere equipment or physical infrastructure) made the creation of a roadmap of pan-European RII a challenging venture. While the original focus was on a strategy-led approach to policy-making and on facilitating multilateral initiatives, the financial and consecutive economic crisis in Europe as of 2008, forced ESFRI to prioritise amongst its RII portfolio and to follow-up on implementation of ongoing ESFRI projects.

Additionally, the establishment of smart specialisation strategies for the European Structural and Investment Funds (ESIF) and the inclusion of RII in these strategies were intended to safeguard a level-playing field amongst the various regions in Europe. The enabling of synergies between ESIF and other EU funding instruments appeared to be challenging and is subject to continuous improvement between the Directorate General for Research and Innovation (DG RTD) and the Directorate General for Regional Development (DG REGIO). Nevertheless, more needs to be done towards simplification and clarity if real synergies are to be achieved. It is not enough to allow regions to share a percentage of their ESIF budget with other regions nor simply to transfer it to the EU Framework programme for research and innovation. In case of international peer-review having taken place at the European level, regional and national funding authorities should not establish own funding criteria nor undertake separate evaluation in order to avoid duplication of efforts for applicants. A single set of rules is crucial and acknowledgement of the European level evaluation results by national and regional funding entities is crucial.

ESFRI and the EC, through the funding of Integrating Activities, have played a pivotal role in spreading a more coherent understanding of RII. Towards this end, and with the goal of optimising the use of scarce resources for increasingly expensive facilities, the EC adopted the European Charter for Access to RI, which sets out non-regulatory principles and guidelines to be used as a reference when defining access policies for RII.

In recent years, the focus is on LTS RII. In 2015, the EC launched a consultation in order to develop a targeted action plan, together with ESFRI and relevant stakeholders. This work aimed at identifying policies and procedures that to safeguard LTS RI and to increase the effectiveness of the existing RII landscape. The EC therewith complemented the work of the Global Science Forum (GSF) of the Organisation of Economic Cooperation and Development (OECD) and the G7 Group Senior Officials (GSO). The Competitiveness Council acknowledged the importance of LTS RII and called upon the EC together with ESFRI and relevant stakeholders to develop an action plan. The EC published its proposal on 26th September 2017 in its Staff Working Document on LTS RII. In March 2018, the Bulgarian Presidency High Level Conference on Research Infrastructures came to reinforce the need to develop a more robust and seamless funding landscape for RII across the lifecycle.

However, we are worried about the non-transparent top down approach and lack of priority setting with regards to the actions to safeguard the LTS RII at European level. So far, the only concrete follow-up to the EC staff working document are within the topical actions under the Horizon 2020 Research Infrastructures work programme and initiatives of different players such as ESFRI and EC. We advise to take a more structured partner-approach gathering support and commitment of all relevant stakeholders (including governments, RTO, RPO and universities) and to deliver solutions. Coordination in delivery by relevant stakeholders is at the core of LTS RI. The ERA doers group to us seems the relevant format for consensus building and coordination.

1.3 DEFINITIONS

The EC defines RI as:

“facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. They include: major scientific equipment (or sets of instruments), knowledge- based resources such as collections, archives and scientific data, e-infrastructures, such as data and computing systems and communication networks and any other tools that are essential to achieve excellence in research and innovation. They may be ‘single-sited’, ‘virtual’ and ‘distributed’.”

Even though this definition of RI has widespread use, its effective application in national and regional levels differs, as demonstrated by the difficulties faced by the project Mapping of the Euro-pean Research Infrastructure Landscape (MERIIL).

Moreover, one common and inclusive definition for RII is increasingly important to avoid differentiating between RI (autonomous entities providing access and services), innovation infrastructures (infrastructures providing their services only to companies and supporting primarily innovation), infrastructures for research (facilities owned by universities to support their research internally) and intermediate forms. Importantly, in this white paper we consistently use the term Research and Innovation Infrastructures (RII) although Research Infrastructures and Innovation Infrastructures superficially might appear different things. The same resource can be used for different purposes depending on the needs of the user. Researchers use RII for executing excellent research, and industry uses them for the testing and demonstration of services, products and instrument technologies.

The sound and long-term sustainable support to excellent research and disruptive and incremental innovation alike, is firmly related with the universities capacity to provide constant support to state of the art education and training, research and transfer of knowledge to business and industry, public services and society at large.

In this paper, we consider it fundamental to acknowledge RII at the institutional level next to RII at the national, European and international levels. RII at institutional level are the heart and soul of the research, education and innovation capacity that the universities provide to other stakeholders in the wider research and innovation ecosystem. Universities manage and operate them primarily to maintain and contribute to educational and research quality and capacity of the university as a whole, a department or faculty. These RII often are open to external national and international users and used by small and large companies. In some cases, the percentage of usage by industry is above 50%: Politecnico di Milano (PoliMi) hosts a wind tunnel and Polifab cleanroom, which get more than 60% of their yearly revenues from services to industry.

National RII are considered in national prioritisation exercises and national RII roadmaps. Universities have an important role in identifying and prioritising needs for RII capacity. Once the need has been prioritised for national funding, universities have important roles as funders, developers, governors, owners and operators often with other partners in consortia. In many countries, large national RII need to be set up in by consortia and universities are hosts to many of these RII and partner to others hosted by other organisations. In any case, universities are the key stakeholder of national level RII, which are often important international references and nodes and hubs of international RII.

International RII are either single-sited or distributed in which several international parties - such as governments or international organisations. Universities often host headquarters and nodes of international RII and contribute significantly with research facilities and research and management staff and related scientific and technical expertise.

Acknowledging the involvement of stakeholders from a continuum of institutional, regional, national, European and international levels is important. The involvement influences the scope of RII, but this continuum does not correspond with 'importance': RII serve different needs and each one of them is part of the RII landscape as a whole.

Center for High Performance Computing
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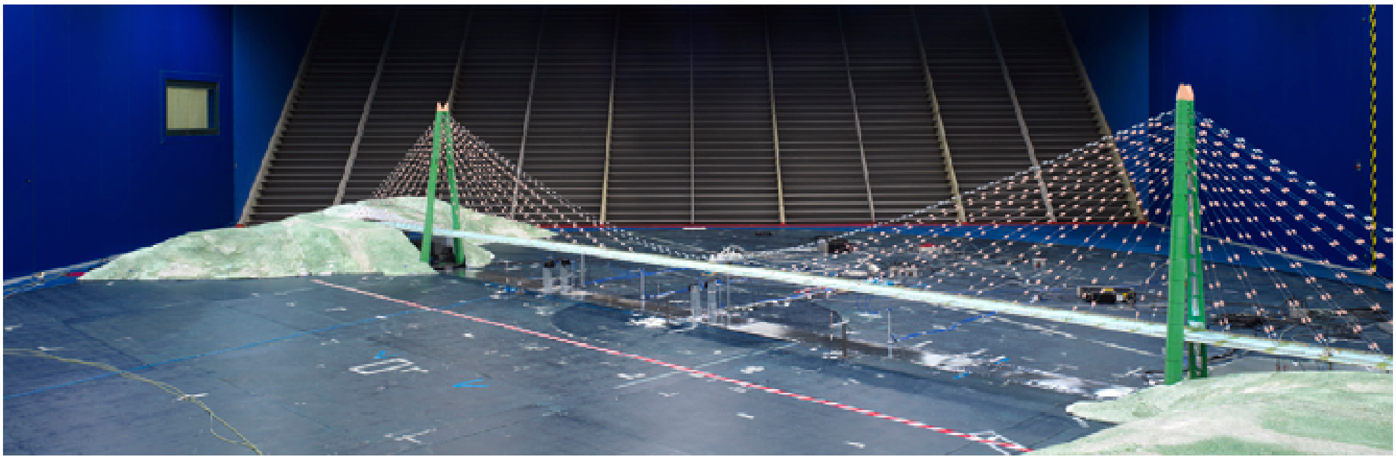
1.4 CONCLUSIONS

In the last two decades, we have made much progress regarding RII policy and funding instruments in Europe. ESFRI contributed to increased coordination and implementation of pan-European RII and inspired wide-spread development of national RII roadmaps. These are important milestones in the recognition of RII as essential elements of research and innovation eco-systems, provided. RII are more visible and their challenges are better addressed. This is particularly true for the effectiveness and efficiency in funding allocation as demonstrated by the Science Europe report on 'Strategic Priorities, Funding and Pan-European Co-operation for Research Infrastructures in Europe' and the InRoad project recommendations.

But we are not there yet: LTS RII is at the heart of the current challenges and acknowledging the crucial roles of universities in RII is pivotal in addressing and solving them. Therefore, it is crucial to abandon linear visions of research and innovation: the sound and long-term sustainable support to excellent research and disruptive and incremental innovation alike, is firmly related with the uni-versities capacity to provide constant support to state of the art education and training, research and transfer of knowledge. Universities also host, own and operate a variety of RII that are simultaneously used by researchers and representatives of other sectors such as business, industry and public services. Altogether, we favour the use of the common and inclusive term 'Research and Innovation Infrastructures' above of just research infrastructures.

Finally, a shared understanding of the concept of RII is related to the common use of its definition. The EC provided a core definition. Acknowledging the involvement of stakeholders from a continuum of institutional, regional, national, European and international levels is important too. This allows policy makers, funders and the research and innovation stakeholders to have a clearer notion of the needs that funding instruments have to respond to. We stress that the RII involve partners and stakeholders from all levels and are all in one or the other way dependent on involvement of researchers from universities. National and European policies and funding instruments should take these roles and the (evolving) institutional RII roadmaps into account.



PoliMi Wind Tunnel
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2. UNIVERSITIES OF S&T AS ENGINES OF EXCELLENCE, TALENT AND INNOVATION

In chapter 2, the roles of universities of S&T as engines of excellence, talent and innovation are elaborated synthesising the case studies provided by leading universities of S&T in chapter 5.

2.1 RESEARCH AND INNOVATION INFRASTRUCTURES AT UNIVERSITIES

Universities design, implement and operate many RII and are also involved in their termination. Such RII or contributions of universities to RII, usually represent strategic priorities of the respective universities, are used by many of its researchers and rely on extensive (national) public funding. Universities recognise the great importance of RII and some are already developing strategic frameworks and institutional RII roadmaps at institutional level. These institutional activities help to achieve common understanding of RII and to introduce criteria with regards to operation, quality and impact.

Characteristics of RII at universities - which are transversally relevant - include the requirement of a well elaborated governance and management structure, provision of training, the formulation of a long-term vision and planning concerning impact, financing and preservation of their excellence, including use, upgrades, evaluation and decommissioning. Leading universities of S&T such as Chalmers University of Technology (Chalmers), the Royal Institute of Technology in Stockholm (KTH) and the Politecnico di Milano (PoliMi) continuously assess the excellence and quality of their RII. KTH as well as RWTH Aachen University (RWTH Aachen) furthermore require a lifecycle of their RII of at least ten years. ETH Zurich goes even further having formulated a framework for RII at different levels, i.e. institute, department, institution and inter-institutional within the (federal) ETH domain.

2.2 DRIVER OF RESEARCH EXCELLENCE

Through the use of RII, universities and industry develop and renew the pool of knowledge in diverse domains, which is needed to create the basis for disruptive innovation in their own regions, countries and Europe. Users of RII come from diverse scientific, industry and societal domains, which in many occasions meet and combine knowledge and methodologies, creating a truly multidisciplinary environment. Virtual and physical RII, such as the Center for High Performance Computing (PDC-KTH), or the wind tunnel at PoliMi (Laboratorio Galleria del Vento) have users spread over diverse scientific fields, from aeronautics, fluid mechanics, climate, computational science, polymer technology, physics, chemistry, materials, mathematics and life sciences. In order to assure that RII drive research, technological development and disruptive innovation, the existence of a strong science agenda established along academic freedom and institutional autonomy is paramount. Socio-economic impact, service-level agreements and KPI for the implementation will not solve the biggest challenge reported by RII in Europe, which is to deliver scientific excellence. This is true for all RII ranging from engineering (such as nanotechnology laboratories, wind tunnels and testing sites for vehicles) to social sciences and humanities such as is the case with the ESFRI RII Digital Research Infrastructure for the Arts and Humanities (DARIIAH). The case from Ghent University describes how DARIIAH-BE is to become CLARIIAH as Ghent University will create a joint national node for DARIIAH and Research Infrastructure for Language Resources and Technology (CLARIN). Leading universities of S&T use, establish and operate RII to support scientific goals.

In many (engineering) RII at institutional level, the confrontation of academic leaders and users from different disciplines results in complex agendas covering and servicing a variety of scientific fields. Therefore, a fundamental differentiation is needed between the quality of service provided by the RII and the quality of the research. This is why the difference between the scientific case and the implementation is so important and must to be taken into account by funders, when de-signing funding instruments (e.g. the quality of RII is not determined by the quality of the research developed and vice versa). With this in view, universities are developing increasing specialisation of RII personnel making available tailor made and diverse range of services to users, ensuring that the service is delivered by competent personnel.

2.3 PROVIDER OF EDUCATION AND TRAINING OF TALENT

RII are crucial for education and training, and for the development of scientific and technical qualifications. These roles can be developed both for the benefit of quality in education and for early impact of a RII, by closely involving academia already when planning and implementing RII. Both undergraduate and graduate training benefit from the existence of RII through direct involvement of students in the research methods, and indirectly through the constant knowledge development that feeds into curricula at all levels. Some examples: Students at PoliMi (from master to PhD level) can access RII and apply the theories learnt through the courses which they are enrolled in. In some cases, they can directly use the equipment inside the facilities to develop prototypes and test new technological solutions. The Nano Imaging and Material Analysis Centre (NIMAC) based in University College Dublin (UCD) is used in masters and advanced undergraduate level education, with an entire course based on using its analytical-characterisation capabilities. The Center for Advanced Research on New Materials, Products and Innovative Processes (CAMPUS) of the University POLITEHNICA of Bucharest (UPB) hosts almost 40% of the PhD students at UPB. At the Norwegian University of Science and Technology (NTNU), the HUNT biobank provides students in medicine with state of the art facilities and support by technical and research staff.

2.4 PROMOTER OF INNOVATION AND IMPACT

Universities of S&T cooperate closely with RPO, RTO and companies and (co-) operate numerous RII, including test and demonstration facilities, testbeds and European innovation hubs. Such RII have the highest added value when they effectively involve partnerships between universities, RPO, RTO, business, industry, public services and society at large. Access to RII and cooperation with partners is crucial to secure effective and open innovation ecosystems. The cooperation and hosting of RII by universities has demonstrated enormous potential as drivers for disruptive, applied and incremental innovation, see for example the case of the Resource for Vehicle Research (REVERE) at Chalmers. Through such RII, universities offer industry and other stakeholders added value through the capacity to influence the development of technologies and to optimise and develop processes, which commercially-oriented RII do not. RII, thus, function as outposts of ground-breaking technological development and innovation. This is why industry and other stakeholders mobilise support and use RII hosted by universities such as the Advanced Research Centre for Quantum Computing and Quantum Internet (QuTech) from the Delft University of Technology (TU Delft) and the Open Access Centre from Kaunas University of Technology (KTU).

RII become enablers, not only of disruptive innovation and technological, social and economic development and competitiveness, but also of more effective innovation ecosystems and value-chains. In Sweden, KTH illustrates this broad role: knowledge transfer in connection to RII takes place in collaborative EU projects with national and international partners. KTH also hosts testbeds, for example a facility for R&D and demonstration of wastewater treatment technologies (Hammarby Sjöstadsverk) and established partnerships in larger testbeds, such as the KTH Live-In Lab test-bed that is run through consortia with strategic partners from industry and others RPO.

In June 2018, PoliMi has signed an agreement with STMicroelectronics for the creation of a Joint Research Centre, based on the extension of PoliMi RII for micro and nanofabrication (Polifab) that will host common activities on MEMS technologies. Other example are TU Delft's testbeds Green Village (a regulation-free zone in which sustainability-innovations can be tested and further developed by researchers, private and public sector partners) and VP Delta, which is a set of testbeds around water innovations, where researchers, start-ups, scale-ups, students, industry and public sector test and develop concepts for water and delta technology.

2.5 OWNER, HOST, OPERATOR, CONTRACT PARTNER AND FUNDER OF RII

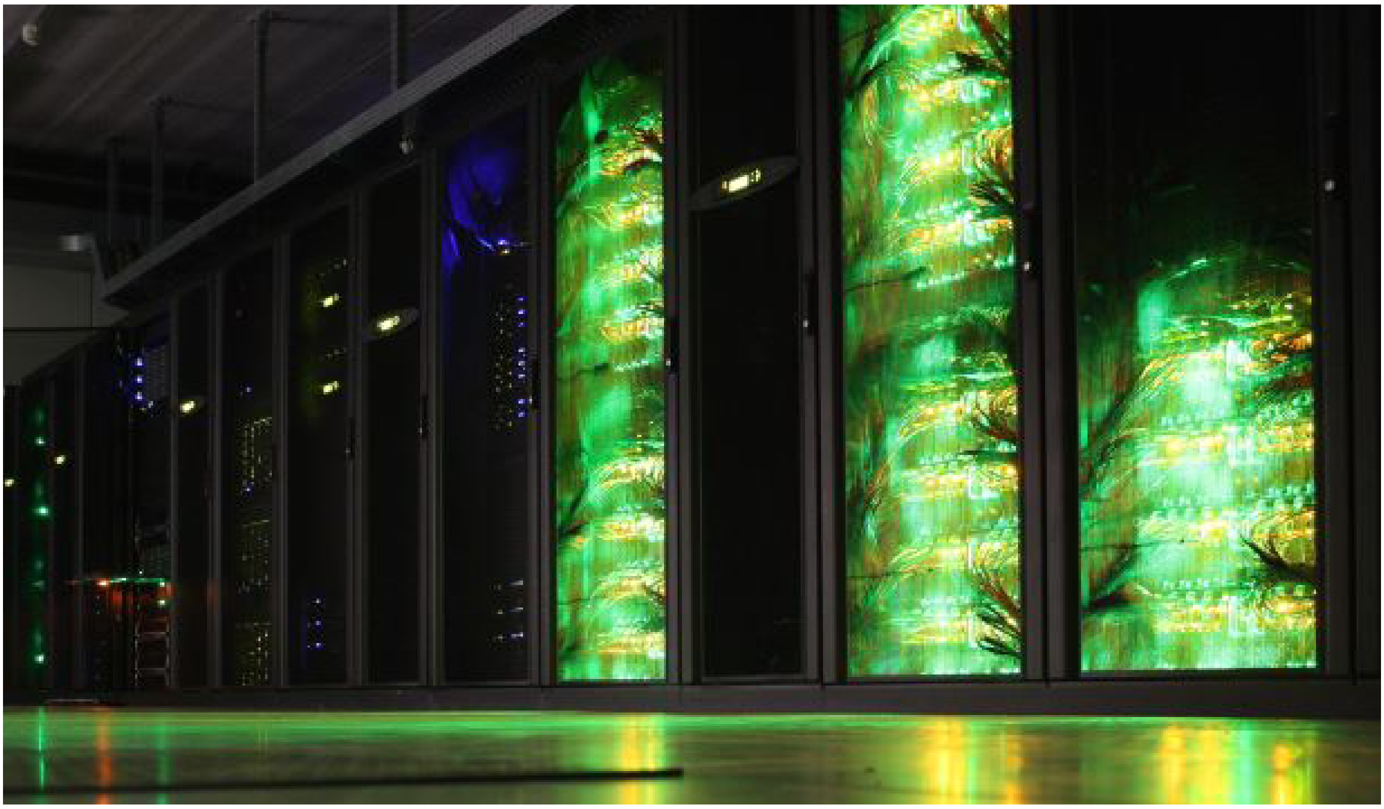
The cases provided in the Technical Annex prove that universities (co-) own, (co-) host and (co-) operate RII at all levels, from the pan-European RII in the ESFRI Roadmap, such as the NTNU's hosting of the headquarters of the European Carbon Dioxide Capture and Storage Laboratory (ECCSEL) or the DARIIAH and CLARIIN nodes at Ghent University, to the national level infrastructures such as CEITEC Nano (hosted by BUT), which is listed on the Czech Roadmap for Major Research Infrastructures, Quantum Facilities at TU Delft among which QUTech, a joint initiative of TU Delft and TNO, which now counts with the participation of several larger technology firms, such as Microsoft and Intel.

Universities work as contract partners to many RII, providing essential services, human resources and essential knowledge for their successful implementation and operation. TU Delft is a partner in the Amsterdam Institute for Advanced Metropolitan Solutions which has field-labs in Amsterdam, testing solutions for metropolitan related issues in an urban setting. PoliMi participates in the development and operation of some beamlines at synchrotron radiation facilities such as the European Synchrotron Radiation Facility (ESRF) and the Elettra Sincrotrone Trieste. University-based researchers are trained and possess the competences to assume responsibility in the governance of RII and to act on behalf of the respective university as contract partner. In many cases, universities fund RII (with own resources) or co-fund them, complementing public funding from national or regional funding agencies and ministries. The models are contingent to each country's university and funding system. With key roles in RII, the users constitute diversified communities. This ranges from university researchers to industry and RTO. Universities increasingly define institutional usage policies in accordance to the European Charter of Access to Research Infrastructures. Nevertheless, it is clear that the vast majority of users in all types of RII are academic researchers. To cite a few representative examples of different types of RII from the case studies: the EuroNanoLab indicates that 87% of users are academic users, ECCSEL amounts to 85% (between internal and external) and the Centre for High Performance Computing (PDC) of KTH indicates that use by academic researchers reaches 70%.

2.6 ADVISOR, DESIGNER, EVALUATOR, GOVERNOR AND MANAGER OF RII

Developing adequate policies and strategies for RII requires informed inputs from the main stakeholders of the respective scientific domain and innovation ecosystem. Researchers and top management at universities play this role towards regional and national governments, as well as towards the EC and international RII organisations. Universities are strongly involved in the national dialogue and debate on policy questions for RII.

University researchers are active in steering, advisory, and user groups at different levels, and design and deliver methods for the development of specific missions and projects that are defined as political or institutional priority. Researchers from universities serve as advisors, designers, evaluators, governors and managers, which constitutes an invaluable asset in policy and decision making. Universities thus are an incredible important pool of talent. For instance, researchers from PoliMi participate in the board of the Human Technopole (i.e. new Research Institute located on the area of EXPO2015). Chalmers actively contributes to the development of MAXIV and ESS in Lund (Sweden) through a) close involvement in the governance and advisory committees of the facilities and b) forming and implementing an corresponding institutional strategy (including staff mobility and the development of instrumentation, modelling tools and complementary laboratories). International academic experts from all scientific fields evaluate RII listed in national RI and ESFRI roadmaps.



Ghent University, High Performance Computing Facilities
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2.7 CONCLUSIONS

In this chapter, we demonstrated that RII are crucial for universities in order to promote scientific excellence, maintain the highest quality in education and training and enable state-of-the-art innovation and impact. Moreover, universities play multiple other and crucial roles in RII. They and other RPO host, co-operate and co-own a significant share of RII. Universities are active partners in operation and funding of national and regional RII and contracting partner to many pan-European, international and global RII. Universities provide the resources for RII to function as enablers of excellent research and innovation. They are also important for the scientific, economic, social and societal impact of RII, for reaching out to society and for creating acceptance for RII. Their researchers and research groups are at the forefront of the scientific case of RII: as frontier (lead) scientists and reviewers of RII. They educate, train and deliver key scientific, managerial, operational and support staff for RII. They are also the employers of researchers as users, advisors and governors of RII. This underlines the importance of closely involving universities in all phases of the RII lifecycle, particularly with regards to national policies and decision-making processes for prioritisation and funding of RII.

Moreover, universities provide the governance framework as well as material (funding, space for facilities) and immaterial resources (such as tacit knowledge and human resources) for research and innovation to flourish. University based or participated RII are increasingly professionalised and tailor-made services are provided to different users. Therefore, universities are crucial for RII, as they are the source of skills, accumulated knowledge, governance and funding capacity, as well as the needed network for internationalisation. RII function as platforms that provide a means to converge various disciplines through the access and use of different users and research teams. The academic use by diverse research teams is the prime guarantee of multi-disciplinarity, knowledge accumulation and disruptive innovation. Therefore, a fundamental differentiation is needed between the quality of service provided by the RII and the quality of the research. Specifically, the outcomes and consequences of the evaluation of the scientific case and of the implementation must be respected at all times.

3. CHALLENGES

In chapter 3, we address the challenges universities face to stay at the forefront of RII and technology. These challenges occur at all levels and include policy and funding constraints. They largely resemble the ones identified by the EC in its Report on the Consultation of Long-Term Sustainability of Research Infrastructures.

3.1 STAYING AT FOREFRONT OF RII AND TECHNOLOGY

In order for RII to remain state-of-the art, adequate funding levels and instruments and sound prioritisation of investments are paramount. It is essential to secure long-term funding for operational costs, which might increase over time, as well as for upgrades. The latter should be foreseen in the initial planning phase and good RII governance needs to initiate the planning process for upgrades in a timely manner.

All phases of the RII life-cycle must be considered from the start and funding instruments must reflect this approach. From this perspective, national RII roadmaps should offer regular reviews of the needs for RII and through adequate analysis and consultation with universities and other relevant stakeholders, suggest how to prioritise and meet the needs of the community with the available funding. As hosts, funders and partners in many of RII, universities are uniquely placed to identify and contribute to decision-making regarding investments in RII.

Importantly, universities have begun to develop institutional RII roadmaps, resulting from state-of-the-art knowledge about what facilities, services and corresponding technical and management capacities are needed to advance science, educate talent and boost innovation. Moreover, such institutional roadmaps demonstrate that universities are key gate-keepers of excellence-driven approaches to RII in support of quality research and science management, including access. Institutional roadmaps are valuable tools for any gap analysis at regional, national and European levels.

Furthermore, some RII require a global analysis of RII landscapes due to their unique nature. Concrete and relevant collaboration mechanisms between ESFRI and major global funders and institutions should be developed for these cases.

3.2 UNCLEAR ROLES AND OWNERSHIP

Clear overall institutional strategies that objectively define roles and ownership rules are central in a coherent and efficient RII institutional system. Exchanges between our Members made clear that investment in RII often results from the researchers' success in research and innovation project applications. Facilitating the transition from equipment perceived as owned by a principal investigator who secured funding from projects for it, to a RII is a considerable challenge for the university leadership and (central) administration. The transition must be beneficial to multi-disciplinarity and sustainability. Thus, it is a ma-

CEITEC Nano, Brno University of Technology
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jor component behind the decision of leading universities' implementation of institutional RII roadmaps. A mind-set change is crucial to ensure long-term planning from the onset. It is therefore important that roles are clarified within the university, in what concerns responsibilities and rights regarding funding received by the university.

3.3 STRATEGY AND PRIORITISATION

Efficient use of resources rests on strategic choices and prioritisation of investments. It is therefore of utmost importance to create a culture for prioritisation at all levels that allows for efficient allocation of funding and resources available. European and national RII roadmaps, but also institutional level planning and roadmaps play a crucial role. As already mentioned, several universities have developed institutional RII roadmaps and institutional RII governance mechanisms. The goal is to use RII efficiently, by communicating what is available and providing user support to both internal and external users, as well as to adequately develop, operate and terminate RII. This underlines an ongoing effort to change the mind-set of researchers and encourage them to look at the available resources at other universities and other disciplines before proposing to set up new RII. In addition, institutional RII roadmaps increase the efficient use of equipment and optimise the offering of access units to external researchers.

When developing an institutional RII roadmap, a university maps the needs for RII, works out a prioritised list which is then split into categories with different actions:

1. Some RII needs are most efficiently handled within the university through coordination between different units.
2. RII are available within other organisations and thus the conclusion is that the university shall develop a coherent strategy to support the RII's host organisation.
3. Universities also discuss a dialogue sharing resources with other organisations.
4. Many needs for RII are too large for a single organisation, and thus the university must try to raise the RII need to national or international RII roadmaps.

3.4 GOVERNANCE AND FUNDING

Governance and funding of RII often overlook critical phases of their lifecycles, leaving universities with heavy burdens concerning their upgrade and decommissioning in particular. The efficient use and allocation of adequate resources for RII in relation to the needs of the users is another particularly important step for increasing the capacity of universities to free resources for the most needed investments. In practice, this means that universities need to look at governance models of RII, plan for the long-term, monitor and follow-up related to state of art and the needs of users.

A major challenge in the governance and funding of RII is related with the creation of sustainable conditions for use. It is often observed that researchers are simply not used to thinking that they have to pay for using a RII. The funders can help increase this awareness by accepting RII usage costs (user fees) in all research and innovation grants. The funders must also accept adequate budgeting for the different cost categories; the researcher should not need to choose between paying salaries for researchers and access costs to RII. This is a crucial aspect of the LTS RI: sufficient and long-term funding is indeed a major challenge in most countries. Whereas the delegation of responsibility of the governance and management of RII to universities is welcome, this is often accompanied by insufficient funding to operate them. Without the sufficient funding, it is not only not possible to upgrade the facilities and equipment and guarantee state of the art research and innovation, but also the usage of RII is compromised through lack of trained staff and trained users as the usage of a RII can be a complex endeavour that needs adequate support from trained staff. In the vast majority of our cases, the university contributes (to a bigger or lesser extent) to the funding of the RII through its own resources, but the LTS RI needs other funding sources to be secured.

The constant development and capacity to provide new research and innovation methods through RII is made possible by the usage of RII by researchers, the contribution RII make to education purposes and the training of researchers. In the majority of the cases around Europe, there are no dedicated multi-annual funding streams to cover these costs. Funding from university funds or grants is flowing ad hoc.

3.5 COMMUNICATION AND ENGAGEMENT

Communicating and clarifying the rules, frameworks and expectations for use, capacitation of existing RII and creation of new ones are crucial for achieving cultural change and, subsequently, more efficient use of the available resources. This must be an integral part of RII roadmaps at all levels. Roadmaps can, themselves, be powerful communication tools. However, engagement of different stakeholders - from the internal community of researchers to external users - needs time, resources, tools and procedures. Relevant means of communication include regular meetings and information sessions, conferences, debates, dedicated websites and newsletters. Researchers can help spreading the word about relevant RII by inviting RII to scientific conferences and ask them to explain specific methods and implementation in their scientific context. Sharing newly developed methods supports the development of the RII in research systems.

3.6 RECRUIT AND RETAIN TALENT

Achieving and maintaining constant levels of high-quality, state-of-art RII requires trained staff and accumulated knowledge and skills to service and manage the RII. One of the greatest challenges faced by universities is to recruit and retain qualified technicians and service staff who like to work in academic environments. These are scarce and highly specialised people. Motivating and rewarding professional careers at RII are essential to guarantee LTS RI. An attractive professional career might include that the role as RII manager is acknowledged within the host organisation and is given the relevant mandate, responsibility and corresponding salary. Needless to say: the career is also more attractive when the service staff is engaged in (and gets a responsibility for) the long-term development of the RII.

3.7 POLITICAL AND LEGAL CONSTRAINTS

It is imperative that RII policy is defined long-term and is not subject to political cycles and constant change in priorities and orientations. Making use of European and national RII roadmaps with associated and committed multi-annual funding is a good practice that should be followed in all countries. Other constraints include the limited agility in public universities' financial and human resource management, excess of red tape, bureaucracy and different rules between funding instruments at regional, national and European levels. This has as a consequence that many useful human resources are wasted in overzealous administrative duties.

Center for Advanced Research on New Materials, Products and Innovative Processes (CAMPUS)
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3.8 CONCLUSIONS

Universities always played a crucial role in the design, preparation, implementation, operation and termination of RII. Moreover, universities optimised the internal organisation of RII, mobilised resources from different stakeholders and cooperated across their institutional boundaries for efficient operation and use. However, universities continue to be seen as mere ´users´ of RII, when in fact, they were and are engines of excellence, talent and innovation enabling the functioning of RII at all levels.

Sustainable research excellence and innovative capacity require thorough use of resources and detailed planning. RII life-cycles need to be considered from the initial design phase to termination. This has profound implications in the structure and rationale of funding instruments, which should respond to the different needs and characteristics across the entire life-cycle. Managing RII at university level means ensuring the combination of quality assurance with adequate access criteria, through clear cut rules and ownership framework. Institutional strategies and RII roadmaps ensure this is delivered and implemented equally across the institution.

In the same way, RII related policy must ensure the development and implementation of prioritisation exercises that allow for an efficient use of resources, promote inter-institutional collaboration and RII use, and eliminate overlapping capacity in favour of reinforced funding where it is most needed. Funding should be made available to RII that promote multidisciplinary research and where diverse scientific domains meet and often pave the way for excellent research and disruptive innovation. Furthermore, the recruitment and training of specialist human resources must be eligible, as universities frequently have to use own resources, promoting the professionalisation and attractiveness of careers at RII. Finally, political stability, keeping long-term funding commitments exempt from political cycles must be ensured.

Resource for Vehicle Research (REVERE)

4. CONCLUSIONS AND RECOMMENDATIONS FOR POLICIES AND FUNDING

In the final chapter and the table below, we present our conclusions and recommendations to improve policy-making and funding of RII. We address the core elements of LTS and the conditions needed to ensure scientific excellence and innovation disruption, including those related with the data challenge, to deliver scientific, social, economic and societal impact and benefit. Although the recommendations are primarily targeted at European policy makers, many are also relevant for national and regional policy makers and funding authorities.

ELEMENTS OF LTS RI	CONCLUSIONS AND RECOMMENDATIONS
ENSURE RII AT FOREFRONT OF SCIENTIFIC EXCEL-LENCE	ENSURE SCIENTIFIC EXCELLENCE AND BREAKTHROUGH: • We underline the importance of establishing sound scientific agendas based on academ-ic freedom and institutional autonomy, underlying the decisions to fund the construction, operation and upgrade of RII. • It is crucial to apply a quality-driven access in-line with the European Charter for Access to Research Infrastructures (i.e. international peer-review). • We underline the importance of making access costs eligible in grants. There is a need for dedicated fund-ing instruments to ensure the constant upgrade of equipment as pre-requisite for scientific excellence. Simultaneously, we recognise the responsibility of in-stitutions that host, own and operate RII to properly develop, plan, monitor and evaluate their business case and later business plans, to ensure a constant upgrade of the instru-mentation and guarantee the access to state of the art instruments enabling cut-ting-edge research and innovation.
CONFIGURE EURO-PEAN RII AS SKILLS DEVELOPMENT AND MOBILITY ACTORS	FACILITATE MOBILITY: • Europe should reinforce its efforts to solve the issues of RII staff mobility across borders alongside with those of other researchers in the implementation of the ERA. We empha-sise the great potential of tax benefit for mobile staff. • We underline the importance of RII for state of the art education and encourage the creation of funding programmes to promote the use of RII by students. • We support the development of a Sectoral Qualifications Framework (SQF) for RII staff and a dedicated scheme linking (retired) mentors and tutors to young talent.
UNLOCKING RII INNOVATION PO-TENTIAL AND STIM-ULATING INDUSTRY ENGAGEMENT	MAXIMISE THE USE OF RII TO BOOST INNOVATION POTENTIAL: • Filling the evident gap in the current Technology Readiness Levels (TRL)-driven linear approach to in-novation requires measures that enable scientific results from RII to feed into disruptive innovation. The European Innovation Council (EIC) should focus on the strengthening of breakthrough and a systems ap-proach. This means privileging the 'Pathfinder' approach in detriment of the 'Accelerator' type of projects, which will be the basis for a long-term and sustainable model of innovation, maximising the use of RII, supported by multidisciplinary and multi-background teams, through the collaborative approach between universities, other RPO, RTO and industry.
BOOST RII IM-PACT, VALUE AND BENEFITS	DELIVER SCIENTIFIC, SOCIAL, ECONOMIC AND SOCIETAL IMPACT AND BENEFIT: • RII are important tools to help universities and other RPO deliver scientific, social eco-nomic and societal impact and benefit. The role of RII is to support the achievement of research and innovation goals set by universities and other RPO. Policies and funding must take this distinction in roles into account. • We support the development of a common, reliable and normalised reference frame-work for impact as-sessment, paying tribute to the diversity of RII as well as the evolution of the impact along their lifecycles. The assessment methodology should be based on a set of common minimal indicators along the lifecycle, essentially linking the external (po-litical) demand for proof of impact with the internal mission, strategy and monitoring of RII. • We urge international players to cooperate closely when defining and collecting standard data on RII, with a view on increasing comparability and reducing the administrative bur-dens to researchers and RII. The identification of the set of common KPI linked to the mission and monitoring of RII opens interesting perspectives for close alignment.

ELEMENTS OF LTS RI	CONCLUSIONS AND RECOMMENDATIONS
ENHANCE RII AS PILLAR FOR DATA PRODUCTION AND SHARING	EXPLOIT DATA ADEQUATELY: • We insist to not simply consider universities as mere \`users\`. It is important to involve the different scientific communities in order to identify their needs and ensure the adequate provision of e-infrastructure and e-services to them. In developing the EOSC, the EU must avoid an escalation of costs comparable to the situation with scientific publications. • Research Data Management (RDM) policies should address and tackle standardisation, interoperability of services and improve research replicability by securing data. Howev-er, we draw attention to the enormous differences between and varying achievements of the scientific disciplines. Therefore, we consider it important that this is a science-driven endeavour.
ENSURE EFFECTIVE GOVERNANCE AND SUSTAINABLE LIFE-CYCLE MANAGEMENT	ADOPT LONG-TERM STRATEGIES AND ASSURE LONG-TERM FUNDING: • ESFRI and funding agencies should assess and monitor the business cases and plans of RII and provide meaningful recommendations directed towards supporting them to move towards implementation. • Europe should adopt long-term visions and approaches to RII monitoring and govern-ance rather than short-term ones. We call upon countries to fulfil their financial obliga-tions in accordance with the ERIC regulation. • The funders should clarify which of their funding instruments cover what costs in what phase of the RII lifecycle: the different expected impacts in the various funding instru-ments (i.e. expected KPI) constitute a problem. They and the procedures and timelines thus should be aligned and simplified. Moreover, the EC should strive towards accepting evaluation and assessment results from ESFRI and funding programmes. • We support the wider analysis of the RII landscapes in dedicated scientific domains, enabling better decisions on the development and termination - e.g. dissolution; disman-tling of facilities and resurrection of site; reuse; merger of operations and organisation; and (major) upgrade - of RII. • Sound RII technical careers need to be promoted: streamline and facilitate recruitment, training and career progression of RII-technical staff - the ‘intellectual infrastructure’. This will reduce barriers for trans-sectoral job mobility.
PROMOTE EUROPEAN RII IN INTERNATIONAL ARENA	PROMOTE ENGAGEMENT AND OUTREACH: • Countries should proactively determine their national RII roadmaps prior to an ESFRI roadmap update allowing for the effective and efficient collection of political support and financial commitment. It is important that national RII roadmaps contain shortlists of RII, which realistically will be funded. Countries should engage all relevant stakeholders with-in their science systems - including universities and regional authorities - when develop-ing their national RII roadmaps. • RII, funders and governments need to internalise public engagement strategies into their mission and allocate funding (e.g. scholarships) accordingly. • Europe should investigate mechanisms for resource sharing at global level.

5. CASE STUDIES

BRNO UNIVERSITY OF TECHNOLOGY (BUT)

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INFORMATION & KEY FIGURES

NAME	CEITEC Nano
ABBREVIATION	CEITEC Nano
LOCATION	BRNO (CZECH REPUBLIC)
CAPITAL VALUE	€ 47 million
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	€ 0,3 million
AVERAGE ANNUAL OPERATION COSTS	€ 2 million
PERCENTAGE OF ACCESS UNITS	55% internal users 43% external users (academic) 2% private users (companies)
LEGAL ENTITY	Not an independent legal entity, but part of BUT
TOTAL FTE EMPLOYED	19,8

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

CEITEC Nano provides complex equipment, expertise and methods for nanotechnology and advanced materials R&D that enable carrying out of complete fabrication of nanostructures and nanodevices and their characterisation down to the sub-nanometre level in an entirely clean environment. Nano started its full operations in autumn 2016 and is included in the Czech RII roadmap

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

CEITEC Nano is part of a wider initiative called Central European Institute of Technology (CEITEC), which was established by a consortium of Brno based universities and research institutes. CEITEC was established with generous support of EU structural funds with start-up funding of more than € 200 mil (investment and operational funding to establish the institute). Part of that funding was devoted to CEITEC Nano.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

Due to recent establishment of full operation of CEITEC Nano, the results are so far limited, while the development of the outputs is very dynamic in the last two years. More than 70.000 booked hours of instruments were used by over 200 users (internal as well as external - academics and companies) in 2017. The contribution to education activities on bachelor, master and PhD level is significant as these user form a strong user base. Also 4 ERC grantees are affiliated to and using CEITEC Nano equipment and expertise. In 2017, 63 peer reviewed publications resulted from CEITEC Nano users.

CHALMERS UNIVERSITY OF TECHNOLOGY (CHALMERS)

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© Chalmers University of Technology

INFORMATION & KEY FIGURES

NAME	Resource for Vehicle Research at Chalmers
ABBREVIATION	Revere
LOCATION	Valdemar Noréns gata 12 in GOTHENBURG (SWEDEN)
CAPITAL VALUE	€ 1,2 million (regional funding and private companies)
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	€ 0 (university contributes only to operation costs)
AVERAGE ANNUAL OPERATION COSTS	€ 0,3 million
PERCENTAGE OF ACCESS UNITS	90% internal users 0% external (academic) users 10% private users (companies)
LEGAL ENTITY	Chalmers

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

The lab is to test and collect data with real vehicles in realistic traffic situations in the scientific fields of active safety, autonomous driving and vehicle dynamics.

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

The owner and operator of the lab is at department level. The President's level follows up regularly according to quality criteria. Individual researchers are users and advisors. Cross-disciplinary strategic research area 'Transport' contributes funding, alignment with research strategies and a strong network with public and private partner organisations.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

An important puzzle piece in the quickly developing 'Transport' node in Gothenburg, where academia, research institutes, SME and industry meet and cooperate in new ways. The node has e.g. attracted governmental and industrial funding for new electromobility innovation lab worth € 100 million. Revere is an important bridge to the AstaZero traffic test field 70 km from Gothenburg, e.g. to make preliminary tests before going to the test field.

CHALMERS UNIVERSITY OF TECHNOLOGY (CHALMERS)

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INFORMATION & KEY FIGURES

NAME	Chalmers' engagement in European Spallation Source and MAXIV
ABBREVIATION	ESS and MAXIV
LOCATION	ESS and MAXIV are located in LUND (SWEDEN)
CAPITAL VALUE	€ 6 million (Construction cost for ESS € 1.9 billion, for MAXIV € 0.2 billion)
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	€ 6 million
AVERAGE ANNUAL OPERATION COSTS	Chalmers contributes € 0,1-0,5 million to the MAXIV operation costs (annual operation cost for MAXIV approx. € 50 million, for ESS approx. € 140 million)
PERCENTAGE OF ACCESS UNITS	(not relevant for this case)
LEGAL ENTITY	Chalmers has collaboration contract with MAXIV and MoU with ESS. ESS is an ERIC, MAXIV is organised within Lund University.
TOTAL FTE EMPLOYED	A few double-affiliated researchers, others are engaged on pro-ject basis.

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

MAXIV and ESS are X-ray and neutron facilities for a broad spectrum of materials science including life sciences, archaeology etc. MAXIV was inaugurated in 2016 and ESS towards 2023.

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

Chalmers' role is to contribute to the scientific development of the infrastructures, and to function as a bridge for our industrial partners with the purpose to facilitate their usage of x-ray and neutron techniques.

We fund and run projects on development of instrumentation, modelling and analysis. We are partners in instrument projects and fund and facilitate mobility (between academia and infrastructures), complementary labs and educational activities.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

Through our engagement, we increase the competence within Chalmers to use MAXIV and ESS, and thereby we increase the quality of our research and innovation; we facilitate the industrial use of MAXIV and ESS to the benefit of society; we train our students on x-ray and neutron techniques and thus form the basis for even broader competence on these techniques in industry and academia in the future.

DELFT UNIVERSITY OF TECHNOLOGY (TU DELFT)

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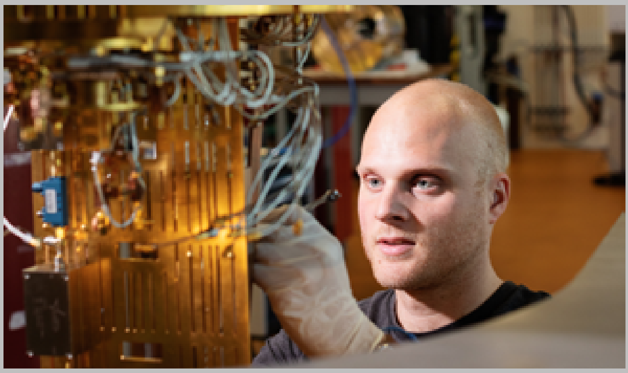


© Marieke de Lorijn

INFORMATION & KEY FIGURES

NAME	Quantum facilities at TU Delft
LOCATION	Faculty of Applied Sciences in DELFT (THE NETHERLANDS)
CAPITAL VALUE	Department of Quantum NanoScience: € 25 million to € 30 million QuTech: € 17 million Kavli NanoLab (supporting infrastructure): € 40 million
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	Quantum NanoScience: € 15 million to € 18 million QuTech: € 9 million in-kind p.a., € 20 million over 10 years Kavli NanoLab: € 2.9 million p.a., of which € 0.2 million p.a.
PERCENTAGE OF ACCESS UNITS	Quantum NanoScience: 100% internal + ext. collaborations QuTech: 100% internal Kavli NanoLab: 85% internal, 1% research, 14% private
LEGAL ENTITY	The department of Quantum NanoScience is one of TU Delft's research departments. The Kavli NanoLab is TU Delft owned. QuTech is part of TU Delft and was founded by TU Delft and TNO.
TOTAL FTE EMPLOYED	3.5 FTE (partly funded outside of operation budget)

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

Quantum research at TU Delft takes place within the Quantum NanoScience department and QuTech, an advanced research center for Quantum Computing and Quantum Internet, building on research infrastructures such as TU Delft Wet Fridges and KAVLI-NanoLab. The Wet Fridges were financed through an ERC Synergy Grant and provide for a unique toplevel research infrastructure. They provide an important asset for top talent to work at QuTech/Tu Delft, form the basis of the many ERC grants and were the X-factor for Microsoft and Intel to collabo-rate with QuTech.

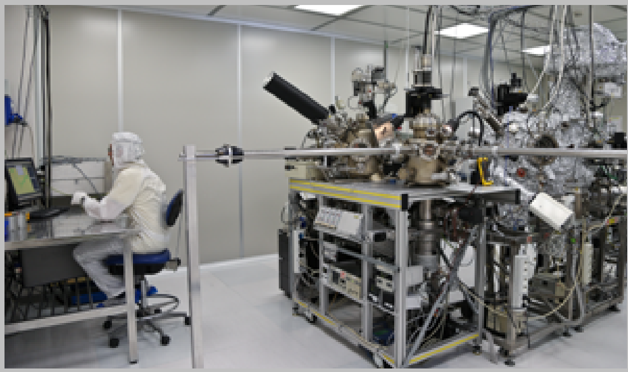
ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

TU Delft is main owner of the QuantumNano, QuTech and Kavli Nano facilities and acts as main contract partner. As such, TU Delft: a) serves as host and provides for the housing, energy and personnel; b) gives an in-cash contribution to QuTech; c) the technicians that operate the infrastructures are TU Delft employed; d) is governing the department and represented in the supervisory board of QuTech.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

Researchers from the TU Delft department of Quantum Nanoscience received in total 15 ERC grants (1 Synergy, 5 Advanced, 2 Consolidator, 7 Starting). In 2015 Intel has invested substantially in a research collaboration with QuTech. In 2017 Microsoft set up Station Q Delft (an experimental research laboratory for quantum computing) and invested substantially in a research collaboration with TU Delft. QuTech Academy offers 5 on-campus MSc courses and 3 specialised MOOC's courses.

EURONANOLAB



© EuroNanoLab

INFORMATION & KEY FIGURES

NAME	EuroNanoLab
LOCATION	Distributed research infrastructure with national nodes in Czech Republic, France, Italy, Netherlands, Norway, Portugal and Sweden. An important role is played by universities of technology as the consortium includes a number of them, e.g. Brno University of Technology, Politec-nico di Milano, Norwegian University of Science and Technology, KTH Stockholm, Chalmers, Delft University of Technology
CAPITAL VALUE	€ 1,6 billion
AVERAGE ANNUAL OPERATION COSTS	€ 53 million
PERCENTAGE OF ACCESS UNITS	Academic users: 87 % Private users / companies: 13 % Nanolabs currently grouped in EuroNanoLab provide service to more than 4.000 users annually who utilise some 760.000 hours of instrument time. Out of them circa 500 are company users.
LEGAL ENTITY	Currently legal entity is not established yet on the EU level. National nodes of EuroNanoLab are consortia involving universities and research institutes

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

EuroNanoLab is a large-scale distributed research infrastructure in the field of cleanroom nanofabrication. By consolidating academic nanofabrication centres, services, and core resources into a single, coordinated nanofabrication infrastructure, EuroNanoLab will support the nanofabrication-related needs of about 10,000 scientists with focus on quantum technologies, 3D nanomaterials and bio-nanotechnologies.

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

EuroNanoLab consortium is composed of a number of universities from across Europe. Universities play quadruple roles within EuroNanolab. First, most of the owners of the facilities (both equipment and buildings) are universities, they operate the national and local nodes of EuroNanoLab, thus providing access to a wide user community. The EuroNanoLab user community is mainly composed of university researchers (although external users are very welcome). Most of the funding for the nanofabrication facilities usually comes from public sources (but, depending on the local arrangements, universities contribute cash or in-kind.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

On the research side, EuroNanoLab has been used to produce about 2800 peer-reviewed papers each year. For its impact on education, being inside universities, EuroNanoLab cleanrooms are also used for the training of students in Nanotechnology. Only in France, EuroNanoLab trains about 600 students (initial learning) and 280 researchers (heavy practice) per year. On the Innovation side: each year, more than 500 companies (big and small) use EuroNanoLab to fabricate their R&D prototypes. Therefore, a number of new technologies are streamlined into market with the help of nanofabrication facilities. An example: CEITEC spin-off company NenoVision, is using CEITEC Nano facility as a showcase for users of its innovative solution of Scanning Probe Microscope designed for easy integration into Scanning Electron Microscopes.

SWISS FEDERAL INSTITUTES OF TECHNOLOGY

INFORMATION & KEY FIGURES

NAME	Swiss X-ray free-electron laser
	SwissFEL
LOCATION	Paul Scherrer Institute (PSI) VILLIGEN (SWITZERLAND)
CAPITAL VALUE	CHF 275.5 million SwissFEL ARAMIS first phase CHF 44 million SwissFEL ATHOS second phase
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	CHF 275.5 million SwissFEL ARAMIS first phase: - CHF 245.5 million funding from federal government - CHF 30 million funding from cantonal government CHF 44 million SwissFEL ATHOS second phase: - CHF 40 million funding from federal government - CHF 4 million funding from cantonal government All numbers refer to investment cost only and do not reflect full costs for construction (i.e. indicated numbers exclude personnel costs)
AVERAGE ANNUAL OPERATION COSTS	Estimate of operating costs (incl. staff and central investments) CHF 25 million / year
PERCENTAGE OF ACCESS UNITS	SwissFEL will offer about 5,000 hours of beamtime per year based on scientific merit granted by external peer review of proposals.
LEGAL ENTITY	Paul Scherrer Institute (PSI) has an own legal entity.
TOTAL FTE EMPLOYED	PSI had about 2,100 employees (FTE) in 2017.

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

Experiments at SwissFEL will lead to an entirely new level of understanding of matter in biology, chemistry, engineering and materials science. The SLS has been highly successful at working out the static structures of many important proteins. With SwissFEL, the very first steps of chemical processes in proteins can be followed opening up new insight into how the human body works. SwissFEL will let scientists observe individual steps of chemical reactions as they happen. SwissFEL will expand understanding about magnetism, how it is created and how it can be manipulated, offering the prospect of squeezing more information into smaller spaces on computer hard drives. Experiments will explore how light can be used to control magnetic data patterns and transfer information at significantly higher speeds than current technology.

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

PSI is mandated by the federal government as a user laboratory to develop, construct, and operate large-scale research facilities, which due to their size and complexity are beyond the scope of university institutes within Switzerland. SwissFEL facility is attached to PSI's Photon Science Division. The realisation of SwissFEL on the present PSI site allows the institute's existing infrastructure to be used.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

SwissFEL is one of only five comparable facilities worldwide, offering Europe access to another FEL in close proximity and expected to make an impact on some scientific areas of relevance for science, society and the economy. As for the other large-scale research facilities at the PSI, the SwissFEL will also be available for use by scientists from research centres, universities and industry – from Switzerland as well as from other countries. Individual arrangements will be made for the use of the facility by industrial partners. For industry, the SwissFEL has already offered opportunities for cooperation prior to operation.

SWISS FEDERAL INSTITUTES OF TECHNOLOGY

INFORMATION & KEY FIGURES

NAME	Swiss Data Science Center
ABBREVIATION	SSDSC
LOCATION	EPFL and ETH Zurich (SWITZERLAND)
CAPITAL VALUE	N/A
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	CHF 30 million over 4 years (2017-2020)
AVERAGE ANNUAL OPERATION COSTS	N/A
PERCENTAGE OF ACCESS UNITS	74 teams of researchers submitted a project proposal in the first access call issued. Eighteen (18) projects from all the institutions of the ETH Domain started in 2017-2018. 4 collaborations with industrial partners, but this number is expected to increase.
LEGAL ENTITY	The SDSC is led jointly by EPFL and ETH Zurich and is part of the Strategic Initiative for Data Science in Switzerland, launched by the ETH Domain in 2017 to accelerate the adoption data science through education and research and the provision of infrastructure.
TOTAL FTE EMPLOYED	Around 30 people. Will host a multidisciplinary team of 40 to 50 data and computer scientists, and experts in select domains, with offices in Lausanne and Zurich.

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

The SDSC is composed of a distributed multidisciplinary team of data scientists and experts in domains including personalized health and personalized medicine, earth and environmental science, social science and digital humanities, and economics. Its mission is to accelerate the adoption of data science and machine learning techniques within academic disciplines of the ETH Domain, the Swiss academic community at large, and the industrial sector. In particular, it addresses the gap between those who create data, those who develop data analytics and systems, and those who could potentially extract value from it. In order to achieve its mission, the SDSC is developing a network of data science support with the aim to: work closely with research groups, foster collaboration between users and data scientists, offer end-to-end data science services (target the research community in Switzerland and beyond, provide a set of software and platform stacks provided “as-a-Service”, backed by academic and commercial cloud services); develop standard agreements with private and commercial partners (get access to valuable, proprietary data for research purposes, experiment with new platforms from commercial vendors); create a data science community (gather users of data science and innovators in data science methods, organize knowledge and tools produced by the community).

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

ETH Zurich and EPFL both contribute to the budget of SDSC. Both offer data science programs for students.
Their scientists participate in the teaching and supervision of master students at the SDSC.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

The SDSC is aiming to accelerate the spread of data science and machine learning within the academic disciplines of the ETH Domain, throughout the scientific community as well as the industrial sector. The SDSC is developing RENKU, an open-source software platform designed to facilitate the exchange of data and knowledge between all the actors involved in data science collaborations, while enforcing their respective data management plans. The platform will ultimately create an international community to share data, tools, methods and information in a federated environment. The online services of the SDSC will be backed by existing infrastructures of the ETH Domain (e.g. by leveraging resources at the Swiss National Supercomputing Centre CSCS in Lugano), SWITCH (the technology and service platform for Swiss universities), as well as those of cloud providers. The SDSC will operate as a cloud-computing provider.

GHENT UNIVERSITY (GHENT)

INFORMATION & KEY FIGURES

NAME	Digital Research Infrastructure for the Arts and Humanities
ABBREVIATION	DARIIAH-EU
LOCATION	Ghent University (BELGIUM)
CAPITAL VALUE	DARIIAH-EU: € 4,3 million (Source: ESFRI Roadmap 2016)
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	Ghent University: € 10 thousand per year = DARIIAH-BE National Coordinator (10% per year) / € 50 thousand per year = 2 Postdoc-toral Assistants: Digital Text Analysis and Geo-Humanities (30% per year for 3 years)
AVERAGE ANNUAL OPERATION COSTS	DARIIAH-EU: € 0,6 million (Source: ESFRI Roadmap 2016)
PERCENTAGE OF ACCESS UNITS	Internal users: 70% (within Ghent University) Research users: 25% (beyond Ghent University) Private users: 5%
LEGAL ENTITY	In-house: Ghent University, Ghent Centre for Digital Humanities. Out-house: DARIIAH-ERIC, C/O TGIR Huma-Num, Paris
TOTAL FTE EMPLOYED	DARIIAH-EU: ca. 8 FTE Ghent University: ca. 3 FTE

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

DARIIAH is a pan-European distributed infrastructure for enhancing and supporting digitally-enabled research and teaching across the humanities and arts.

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

The Ghent Centre for Digital Humanities is the National Coordinating Institution for DARIIAH-BE. It offers a sustainable portfolio of services enabling digital scholarship in the arts and humanities at Ghent University, Flanders, Belgium and beyond.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

Tools and guidance for the whole research project lifecycle where digital tools, methods or collections are used, with a specific focus on digital text analysis, collaborative databases and geospatial analysis.

GHENT UNIVERSITY (GHENT)

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INFORMATION & KEY FIGURES

NAME	HPC-UGent High Performance Computing facilities
ABBREVIATION	HPC-UGent
LOCATION	Ghent University (BELGIUM)
CAPITAL VALUE	€ 9,3 million (infrastructure only)
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	About € 4 million in infrastructure Since 2016, Ghent University receives structural cofunding from FWO (Flemish national research institute), in the con-text of the Flemish Supercomputer Center consortium, to help cover infrastructure and personnel costs.
AVERAGE ANNUAL OPERATION COSTS	Infrastructure: € 1,2 million Personnel: € 0,9 million Training and outreach: € 50 thousand
PERCENTAGE OF ACCESS UNITS	Usage in terms of used computational time: Internal users: 99% (within Ghent University) Research users: 99% (entire Flemish academic landscape) Private users: currently less than 1% (data from 2017)
LEGAL ENTITY	Central ICT department of Ghent University
TOTAL FTE EMPLOYED	7 FTE

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

HPC-UGent provides centralised scientific computing services, training, and support for researchers from Ghent University, industry, and other knowledge institutes. (https://www.ugent.be/hpc)

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

Ghent University fully owns and manages HPC-UGent, functioning as one of the nodes within the Flemish Supercomputer Consortium. Through its services, Ghent University aims to boost the skills and innovation capacity in terms of scientific computing of all stakeholders in research and development in Flanders.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

HPC-UGent is broadly used in education (~13%) at Bachelor and Master level, and research (~87%). It is Tier-2 platform, successfully preparing users for speeding up and scaling up applications towards Tier-1 and Tier-0 level infrastructures. Effective usage in terms of used computational time is near 80%. Innovation development towards private companies and industry is limited, as uptake of scientific computing in the Flemish industrial landscape is still lagging in critical mass. A number of recent success stories with spinoffs and industrial partners bolster confidence.

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (NTNU)

INFORMATION & KEY FIGURES

NAME	European Carbon Dioxide Capture and Storage Laboratory - European Research Infrastructure Consortium
ABBREVIATION	ECCSEL ERIC
LOCATION	NORWAY (statutory seat and operations centre); France, Italy, the Netherlands, Norway and the UK (location of the facilities which are part of the distributed, integrated European ECCSEL Research Infrastructure)
CAPITAL VALUE	€ 1000 million (estimated)
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	€ 50 million (estimated)
AVERAGE ANNUAL OPERATION COSTS	€ 480 thousand in 2018 (raising to € 850 thousand by 2021) for operation costs of ECCSEL ERIC Operations Centre (excluding op-eration costs of the included research facilities)
PERCENTAGE OF ACCESS UNITS	Estimated 50% internal users, 35% research users and 15% private users
LEGAL ENTITY	ERIC
TOTAL FTE EMPLOYED	3.5 in 2018 (raising to 6.5 in 2021)

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

ECCSEL is a distributed RII for research to help enabling low to zero CO2 emissions from industry and power generation to combat global climate change.

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

NTNU hosts the ECCSEL ERIC Operations Centre, employs some of the to ECCSEL seconded staff and pro-vides admin support. NTNU leads the National ECCSEL Node and is owner & operator of facilities which are part of the ECCSEL Research Infrastructure.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

ECCSEL is extending greatly the number of CCS research facilities NTNU has access to. It is attracting world-wide external students and researchers to NTNU and is promoting external cooperation.

NORWEGIAN UNIVERSITY OF SCIENCE AND TECHNOLOGY (NTNU)

INFORMATION & KEY FIGURES

NAME	HUNT Biobank, Norwegian University of Science and Technology
ABBREVIATION	NTNU
LOCATION	LEVANGER (NORWAY)
CAPITAL VALUE	For HUNT biobank the RV for facilities and technical installations is approx. € 22 million (NOK 200 million). RV related to rebuilding of existing sample collections amounts to € 39 million (€ 350 mil-lion). This is based on costs involved in recruitment of study-participants, sample collection and sample handling, as well as analyses, storage and handling of a growing dataset/data collec-tion. A total RV will then be approx. € 51 million
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	Approximately 40% of RV - ~ € 20 million
AVERAGE ANNUAL OPERATION COSTS	€ 3,3 million (for HUNT biobank and research center)
PERCENTAGE OF ACCESS UNITS	Internal users: 10 Research users: 80 Private users:10
LEGAL ENTITY	Part of NTNU
TOTAL FTE EMPLOYED	30 FTE

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

HUNT biobank is based on the HUNT study, a population based health survey covering age groups >13 years recruited form the entire county (130 000)

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

NTNU is the owner of HUNT Biobank, organised as a research unit under the Faculty of Medicine and operated by both scientific and technical personnel. Main funders are NTNU, the County Council, Ministry of health. User fee for access is implemented

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

Based on the HUNT study and biobank, approximate 100 peer reviewed papers are published annually, 173 PhDs have been completed and we teach and train students in medical school and other master programmes

KTH ROYAL INSTITUTE OF TECHNOLOGY

© KTH Royal Institute of Technology

INFORMATION & KEY FIGURES

NAME	Center for High Performance Computing
ABBREVIATION	PDC
LOCATION	STOCKHOLM (SWEDEN)
CAPITAL VALUE	€ 19 million (SEK 190 million)
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	€ 8,2 million (SEK 8,2 million). The full investment is: SEK 82 million invested by KTH, SEK 78 million invested by the Swedish Research Council via SNIC, and SEK 30 million by the company Scania.
AVERAGE ANNUAL OPERATION COSTS	€ 5 million (SEK 50 million)
PERCENTAGE OF ACCESS UNITS	Internal users: less than 1% (research users from the department of PDC, here all research project in the area of developing HPC in Europe are included); Research users – running massively parallel jobs: 70% (this number consist of 42% research users at KTH, 53% research users from other Swedish universities, 5% European re-search users via PRACE) Private users running massively parallel jobs: 30% (mainly Scania)
LEGAL ENTITY	KTH
TOTAL FTE EMPLOYED	30 FTE

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

PDC is the leading provider of high performance computing (HPC) and storage services for academic research in Sweden. PDC's services are made available to Swedish and European researchers, respectively via the Swedish National Infrastructure for Computing (SNIC) and PRACE. PDC also provides its services to the commercial sector via collaborative projects. PDC's current flagship system "Beskow" – a 2,5 PF Cray XC40 system which currently is the most powerful academic system in the Nordic countries – is dedicated for running massively parallel jobs. Pre- and post-processing facilities are available via PDC's Tegner system. Users are spread over many scientific fields, including aeronautics, fluid mechanics, climate, computational science, polymer technology, physics, chemistry, materials, mathematics and life sciences.

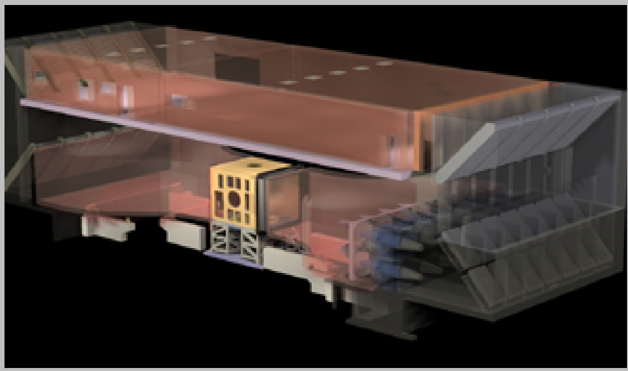
ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

KTH is full owner, operator, user, designer and the largest funder for PDC. Since an important part of the infrastructure is to have application experts with a background in research in a particular scientific area, along with extensive experience using HPC programs and applications in that area, KTH is also an advisor to researchers.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

PDC resources are used in various KTH education programs on both undergrad and postgrad levels and education in HPC is offered at KTH. PDC is instrumental in providing supercomputing for a number of exceptionally strong Swedish environments that are world-leading in modelling and simulation – ranging from numerical analysis and research in turbulence to materials and life sciences. PDC is currently heavily involved in an ongoing project to establish a storage system for Swedish research data. PDC work with both SMEs and large businesses, providing Master students for research projects, HPC services and consultancy. PDC's facilities are also used for some commercial research (for example by Scania). PDC offers both commercial and open-source software suitable for use in many different industry segments.

POLITECNICO DI MILANO (POLIMI)



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INFORMATION & KEY FIGURES

NAME	PoliMi Wind Tunnel - Laboratorio Galleria del Vento
ABBREVIATION	GVPM PoliMi
LOCATION	Campus Bovisa La Masa, Edificio B19, Via Giuseppe La Masa in 34 20156 MI-LANO (ITALY)
CAPITAL VALUE	€ 20 million
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	€ 20 million
AVERAGE ANNUAL OPERATION COSTS	€ 350,000 per year
PERCENTAGE OF ACCESS UNITS	10% internal self-financed research users 30% externally funded research users 60% private commercial users
LEGAL ENTITY	Part of PoliMi
TOTAL FTE EMPLOYED	7 FTE

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

PoliMi designed the facility to provide technological tools for both aerodynamic and wind engineering test solutions together with a strong commitment to research. GVPM is a special closed-circuit wind tunnel arranged in a vertical layout with two test rooms in the loop.

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

PoliMi is the founder, owner and governor of the facility and hosts it on its Bovisa Campus in Milan. GVPM is operated by PoliMi staff in order to fulfil the test schedule set by PoliMi advisors and users together with their cus-tomers.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

N° 2 EU funded research projects per year produce research deliverables.
N° 10 MSc students and N° 2 PhD students per year write a thesis on activities carried out at GVPM.
N° 10 commercial projects per year provide innovative know-how contribution to industry coming from or based on wind tunnel experiments.

UNIVERSITY POLITEHNICA OF BUCHAREST (UPB)

INFORMATION & KEY FIGURES

NAME	Resource Center for Grid and Cloud Computing
ABBREVIATION	CerCCo
LOCATION	BUCHAREST (ROMANIA)
CAPITAL VALUE	€ 10 million building infrastructure € 2.5 million equipment infrastructure Capital Value (CV) = € 12.5 million Replacement Value (RV) = € 12 million Constant upgrade (estimated annual costs) = € 0.5 million
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	University invest into capital value € 500 thousand and for constant upgrade € 250,000 The other costs were covered by European Structural Funds (86%) and by National and European Research Projects (14%)
AVERAGE ANNUAL OPERATION COSTS	Average annual operation costs: € 480 thousand
PERCENTAGE OF ACCESS UNITS	Percentage of access units per Internal users: 68% Research users: 23% Private users: 9%
LEGAL ENTITY	Resource Center for Grid and Cloud Computing is part of UPB.
TOTAL FTE EMPLOYED	25 FTE researchers

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

The infrastructure offers support for national and international research projects (2.000 processing cores and over 30.000 GPU cores) in Cloud computing, Big Data, Smart Cities, and many others fields.

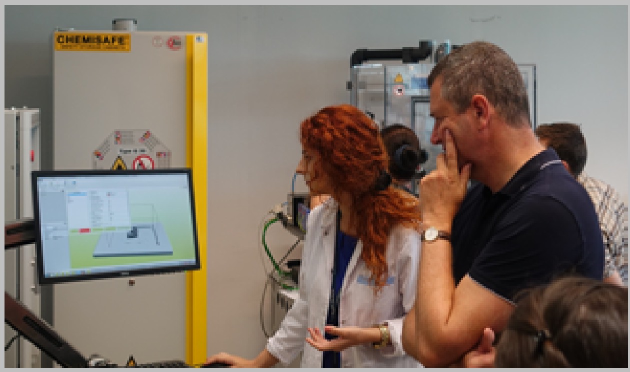
ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

UPB's researchers are developer of technology and science, acquiring competences by participating with many institutions in Romania and worldwide, to use the expertise of the RII. CerCCo is an RII recognised officially in Romania and included in the national infrastructure for installations and objectives as national centre of interest.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

The resources of CerCCo are mentioned in the national catalogue www.erRII.ro. CerCCo has signed agreements with partner institutions ICI, INCAS, IFIN, UB, UTCN and many others, supports part of the Alice experiment at CERN and is included in the national infrastructure for installations and objectives. It has an important role in support-ing Grid and Cloud Computing training and education activities.

UNIVERSITY POLITEHNICA OF BUCHAREST (UPB)



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INFORMATION & KEY FIGURES

NAME	Center for Advanced Research on New Materials, Products and Innovative Processes
ABBREVIATION	CAMPUS
LOCATION	Splaiul Independenței 313, 060042 BUCHAREST (ROMANIA)
CAPITAL VALUE	Capital Value (CV) = € 33 million (includes: design and construction costs, building infrastructure and equipments infrastructure) Constant Update (estimated, average) = € 600,000
UNIVERSITY INVESTMENT INTO CAPITAL VALUE	UPB investment = € 300 thousand (the other costs were covered 83% from European Structural Funds and 17% from the National Budget).
AVERAGE ANNUAL OPERATION COSTS	Average Annual Operation Costs = € 1.3 million (includes utilities costs, technological and research equipments maintenance costs, consumables and accessories costs, equipment upgrade costs, security staff costs, administrative staff costs, research and sup-port staff costs - 50 Full Time Equivalent Employees)
PERCENTAGE OF ACCESS UNITS	Internal users: 18% Research users: 80% Private users: 2%
LEGAL ENTITY	Part of UPB (in-house)
TOTAL FTE EMPLOYED	50 FTE researchers

SHORT DESCRIPTION OF RESEARCH & INNOVATION INFRASTRUCTURE

The CAMPUS is a multi- and inter- disciplinary research centre conducting innovative research in the fields of applied chemistry and materials, mechanics & mechatronics, electronics, electrical engineering, power engineering, telecommunications, information technology and computer science and automatic control.

ROLE OF UNIVERSITY IN RESEARCH & INNOVATION INFRASTRUCTRURE

UPB is the funder, owner and operator of CAMPUS, which was built to crystallise the most advanced research groups from UPB into a truly interdisciplinary research facility. It explores new frontiers between the different fields studied within UPB's 16 faculties.

RESEARCH & INNOVATION INFRASTRUCTRURE OUTPUTS IN TERMS OF RESEARCH, EDUCATION AND TRAINING AND INNOVATION

CAMPUS is also an educational centre for undergraduate and postgraduate studies and e-learning. Students are conducting their research projects supervised within the CAMPUS laboratories. As well, new breakthroughs from research are constantly adopted to the university curricula.