European Commission

Assessing the projects on the ESFRI roadmap

A high level expert group report

Research and Innovation

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Cover picture: the CSIRO's Australian SKA Pathfinder (ASKAP) telescope, located at the Murchison Radio-astronomy Observatory (MRO) in Western Australia

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FOREWORD

Support for the development and operation of new and existing research infrastructures of European relevance has been an important aim of the European Commission and Member States for several years, and remains crucial for the completion of the European Research Area.

Implementing the facilities on the roadmap of the European Strategy Forum for Research Infrastructures (ESFRI) is critical for the EU to remain at the forefront of science and technology and be competitive in a global knowledge-based economy. That is why the EU has set itself the target of implementing at least 60 % of the ESFRI roadmap projects by 2015 through its Innovation Union flagship initiative.

This process should be accompanied by sound assessment of the progress that projects have made since they were put on the ESFRI roadmap. Therefore, the European Commission decided together with ESFRI to ask a high-level expert group to conduct an in-depth analysis of all the non-scientific aspects of the projects.

The main objective of this exercise was to identify the open issues and bottlenecks that are currently delaying the implementation of the ESFRI roadmap projects and to assess whether these projects are likely to be implemented by 2015.

The Assessment Expert Group wanted to understand in detail the development of the projects and provide a useful tool for the projects' development towards implementation. The report therefore offers detailed recommendations on how to overcome their difficulties. A lot of work still remains to be done by the projects, stakeholders, Member States and the European Commission to ensure that these projects are realised. The recommendations therefore deserve careful study.

The European Commission wishes to thank the experts and the project representatives for their excellent cooperation and trusts that the considerable body of work contained in this report will be useful to all stakeholders. It is not only a critical appraisal of the situation of the ESFRI roadmap projects but is also an important tool for disseminating best practices and developing future research infrastructure projects.

Robert-Jan Smits

Director-General
DG Research & Innovation

EXECUTIVE SUMMARY

Research infrastructures are a key component of the European Research Area (ERA). In order to assess progress towards the Innovation Union objective of launching or completing the construction of 60 % of the ESFRI projects by 2015 and to consider the type and level of EU support which could be devoted to the ESFRI projects under Horizon 2020, the European Commission (EC), together with ESFRI, has decided to establish a high-level Assessment Expert Group (AEG). The group is composed of reputed professionals in the field of research, listed hereafter in alphabetic order: Professor Alfonso Franciosi (University of Trieste and Chief Executive Officer, CEO, Elettra-Sincrotrone Trieste), Professor Sine Larsen (University of Copenhagen), Dr John Marks (former Deputy CEO, European Science Foundation, FSF), Dr Karl Tichmann (former Managing Director, Max Planck Institute for Plasma Physics, IPP), Professor Richard Wade (former Chief Operating Officer, Science and Technology Facilities Council, STFC), and Professor Milena Zic Fuchs (University of Zagreb). Dr Antonella Calvia-Goetz, an expert on research infrastructures at the European Investment Bank, EIB, chaired the group ([1]).

The AEG was appointed in August 2012. According to the Terms of Reference ([2]) (ToR), the AEG was tasked with evaluating the financial and managerial maturity of thirty-five research infrastructure projects on the ESFRI Roadmap (Roadmap). The report on each individual research infrastructure project should clearly identify specific bottlenecks and make recommendations on how to address them. The assessment must also evaluate the feasibility of these research infrastructures being implemented by 2015 in order to fulfil the commitment of the Innovation Union Flagship Initiative that, '*By 2015, Member*

1 All experts act on a personal basis. The work of the Assessment Expert Group does not engage in any way with any of their institutions (including the European Investment Bank).

2 See Annex 1 for the Terms of Reference.

States together with the Commission should have completed or launched the construction of 60 % of the priority European Research Infrastructures currently identified by the European Strategy Forum for Research Infrastructures.'

The AEG decided to carry out the assessment by building on the UK gateway process, a well-proven tool developed for evaluating project proposals in a wide range of disciplines. The assessment was performed by developing an Assessment Matrix comprising six modules: Cost and Financial Structure, Governance and Legal Structure, Stakeholder Engagement and Financial Commitments, Human Resources and Project Management, User Strategy and Risk. The Assessment Matrix lists the milestones related to different stages of maturity ([3]) in the three identified key phases of project preparation: Preparatory, Approval and Implementation. On this basis, an AEG Questionnaire with a number of standard questions was sent to the research infrastructure teams with a reply deadline of 15 December 2012 ([4]). Representatives from each research infrastructure were subsequently interviewed in Brussels over the period of January to March 2013, to obtain a deeper knowledge of the projects and clarify issues resulting from the answers to the AEG Questionnaire.

For the purpose of the AEG Report, a research infrastructure is considered to be 'mature', i.e., ready for implementation, when it meets the main following criteria:

- Cost and financial plan are well defined, with adequate cost estimates;
- Firm financial commitments for the relevant investments and operations;
- Approved statutes and governance structure are in place;
- Existence of a credible project organisation, with clearly identified responsibilities and reporting lines;
- Key Performance Indicators (KPIs) are established and staff planning outlined, including procurement considerations;
- User Strategy is well planned;
- Risk Analysis is included.

The final assessment result for the thirty-five research infrastructure proposals is as follows:

- Category one lists projects which meet the criteria to be ready for implementation by 2015, if the management makes a good effort to address the AEG recommendations. The eight research infrastructures in this category are: BBMRI, EISCAT-3D, ELIXIR, ESS, EURO-ARGO, IAGOS, INFRAFRONTIER and SKA. However, even for these research infrastructure projects that are close to maturity, financial commitments have not been secured in many cases.
- Category two lists research infrastructures which might be able to achieve maturity by 2015, if substantial action is implemented to address the bottlenecks and weaknesses identified in terms of financial and managerial maturity. These eleven research infrastructures are: CLARIN, CTA, DARIAH, EATRIS, ECRIN, ELI, EMBRC, EPOS, ICOS, INSTRUCT and LIFEWATCH.
- Category three lists all research infrastructures that have minimal chance of achieving maturity by 2015. These sixteen research infrastructures include proposals that recently entered the Preparatory Phase of the Seventh Framework Programme

3 See Annex 3 for the Assessment Matrix.

4 See Annex 2 for the Questionnaire.

(ANAEE, EU-SOLARIS, ISBE, MIRRI and WINDSCANNER) or are still in the Preparatory Phase (ECCSEL, EU-OPENSCREEN, EUROBIOIMAGING and SIOS). In other cases (ERINHA, EUROFEL, EMFL and EMSO), the research infrastructure proposals show that although the participating institutions could have developed a joint work-plan, funding plans, governance and project organisation for a fully integrated distributed research infrastructure, they showed insufficient inclination to do so and the outcome presents significant gaps. In the remaining cases (COPAL, HiPER and KM3NeT), the research infrastructures have made little progress towards their stated target over the years, or major recent changes in scope and/or approach relative to the original submission have taken place.

It should be stressed that belonging to the second or third category does not necessarily imply a lower priority for the support of such projects, in particular because any prioritisation should start by considering the scientific importance and the societal impact of the research infrastructures, both aspects which have been specifically excluded from this assessment exercise. Also, planning the establishment of a research infrastructure takes time and some of the research infrastructures which have been on the roadmap since 2006 are only now approaching maturity, after a long Preparatory Phase. The research infrastructures, which entered at a later stage, should be given a fair opportunity to develop.

To reinforce the projects' readiness to maturity, the AEG makes the following overall recommendations.

Management of the Roadmap:

- A process improvement of the Roadmap should be considered, using a form of 'Stage-Gate-Review'. This should include:
  - Appropriate guidelines listing all milestones by stage of project development in each module, as proposed in the Assessment Matrix.
  - Independent reviews before research infrastructures are allowed to pass the 'gate' in the different stages of the research infrastructure development.

Financial issues:

- Commitments for funding should be addressed at ministerial level. A clear definition of 'who decides what' for the research infrastructures should be developed.
- Templates for financial plans should be developed, based on benchmarks.
- Cost engineering should be based on generally agreed principles.
- Rules for research infrastructure funding under Horizon 2020 and Structural Funds should be synchronised to ensure operational maturity and consistency in investments.

Governance:

- Apart from the necessity of raising awareness of starting on governance/legal issues as soon as possible, training courses on governance and project management for the research infrastructures in different stages should be organised. Regarding statutes, at least some structure and building blocks should be recommended and best practices should be shared.

Value-addition of an integrated research infrastructure at European level:

- Central hubs should be reinforced to enable the distributed research infrastructures to reach the level of an integrated European research infrastructure instead of a (valuable) network of facilities with an access programme. Some degree of oversight of the overall investments and operations should be exercised by the central management.
- The value added to the European research infrastructure should result from improved services and quality standards for the science mission, which cannot be reached at national level.

Management, user strategy and risk:

- Expertise involving industrial partners should be built up to foster true public-private partnerships.
- Research infrastructures in related fields could benefit from exchanging expertise and using common standards for data, from sharing facilities and approaches and from joint engagement of overlapping user groups. This potential for synergy is sometimes identified, but not always further developed.
- Procurement should be managed by international task forces with a track record to avoid duplication of costs and efforts. The potential for synergies of investments made by the national nodes should be addressed.
- Risk management should be introduced as a work-package.

The results of this review show that most research infrastructures on the ESFRI Roadmap need substantial support and guidance, both in terms of managerial and financial maturity but also regarding stakeholder engagement, project management, user strategy and risk evaluation. In most cases ethical issues have also been underestimated.

1 INTRODUCTION

Research infrastructures are a key component of the European Research Area (ERA). They bring together a wide variety of stakeholders to search for solutions to the scientific problems being faced by society today. They offer unique research opportunities to users from different countries and from different disciplines, attract young scientists and help to shape scientific communities. They play an increasingly important role in the advancement of knowledge and the development of technology to help Europe compete in an increasingly globalised knowledge economy. Research infrastructures contribute to making the Europe 2020 Strategy and its Innovation Union Flagship Initiative a reality ([5]). Moreover, research infrastructures should help to realise the potential of the regions, to increase international cooperation and continue their opening to, and partnership with, industrial researchers to help address societal challenges and support EU competitiveness.

The ESFRI Roadmap for research infrastructures, published in 2006 and subsequently updated in 2008 and 2010, is a vital policy document that paves the way for the planning, implementation and upgrading of research infrastructures of pan-European relevance for the coming decades.

Implementation of the projects on the ESFRI Roadmap is a priority for ESFRI and the European Commission in order to fulfil the commitment of the Innovation Union Flagship Initiative that, 'By 2015, Member States together with the Commission should have completed or launched the construction of 60 % of the priority European Research Infrastructures currently identified by the European Strategy Forum for Research Infrastruc-

5 http://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication-brochure_en.pdf

tures.' The conclusions of the December 2012 Competitiveness Council ([6]), emphasising 'the need for renewing and adapting the mandate of ESFRI to adequately address the existing challenges and also to ensure the follow-up of implementation of already ongoing ESFRI projects after a comprehensive assessment, as well as the prioritisation of the infrastructure projects listed in the ESFRI Roadmap', should be seen in this context.

In order to proceed with its work, ESFRI needs to identify for each project on the Roadmap the main issues that remain to be tackled for their implementation. This requires a significant effort from all stakeholders and projects.

The ESFRI Implementation Working Group has been interacting with the research infrastructure projects on the Roadmap to understand their issues, stumbling blocks and bottlenecks. Members of the Implementation Working Group have taken a holistic and general approach (without looking in detail at the individual projects), concentrating on forming an overview of the biggest non-scientific issues that the projects are facing. According to its report ([7]), another sixteen projects are likely to start being implemented by the end of 2015.

A more detailed assessment of the progress towards implementation of the Roadmap was considered necessary for each research infrastructure. Consequently, the European Commission, together with ESFRI, decided to set up a high-level Expert Group with experience in financial, management, governance, access and ethical issues. The primary objective of this Assessment Expert Group was to evaluate the financial and managerial maturity of the projects of the ESFRI Roadmap. A scientific evaluation will be one of the tasks of the ESFRI Strategy Working Groups in the coming months and therefore this has not been carried out by the AEG. Likewise, neither the ten projects highlighted as success cases and 'in the implementation phase' in the 2010 Roadmap, nor the projects under the direct control of ESO, CERN and those in the framework of the Euratom Treaty, were included in the present analysis, since these organisations are entirely responsible for the assessment, development and construction of these projects. Nevertheless, a separate assessment of all these projects would be highly desirable at a later stage to make certain that they are on the right track and that important issues, such as long-term sustainability and operations, are correctly taken into account. The present assessment has therefore focused on thirty-five research infrastructures.

To assess each of these projects, the AEG applied the same detailed methodology based on a new Assessment Matrix, described in detail in Chapter 2, independently of whether they have been reported as 'under implementation' by the ESFRI Implementation Working Group. Such an in-depth analysis has inevitably led to differences in the final assessment of the projects from that of the ESFRI Implementation Working Group. The AEG Report shows that some projects that started implementation and are therefore overall considered mature by the ESFRI Implementation Working Group, are nevertheless not considered mature in one or more assessment modules as seen from the AEG's point of view. This result does not contradict the conclusions of the ESFRI Implementation Working Group, but rather highlights issues that have been insufficiently addressed by the projects and therefore should be taken up urgently to ensure that they are implemented following best practice. This also applies to those projects that have chosen the European Research Infrastructure Consortium (ERIC) as the legal entity for their implementation.

6 http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/intm/134168.pdf

7 http://ec.europa.eu/research/infrastructures/pdf/esfri_implementation_report_2012.pdf#view=fit&pagemode=none

All projects have been asked to submit detailed up-to-date information which included the latest estimates for construction and operations costs. The AEG was not in a position to validate these costs, but only reports the costs as quoted by each project. It is therefore important to stress that as construction costs are not validated, these should be part of the periodic review process which is part of the overall recommendations. The distinction between project costs and the costs of national nodes for distributed research infrastructures is not yet fully defined in a systematic way. In some projects, the overall costs include the investments by each national node, in others, only the additional investments of the central hub.

Chapter 3 reports the detailed assessment of each individual project, identifying specific bottlenecks and giving recommendations on how to address these to give the project the best chance to be implemented in a timely fashion.

Lastly, Chapter 4 summarises the overall findings, and indicates which projects are on track to be implemented by 2015, which ones have a chance of making it by 2015, if effective action is taken quickly in a number of areas, and which projects have minimal chances of implementation by 2015, and the reasons why. A clear distinction must be made between projects that have only recently been put on the Roadmap, and therefore need the time to develop and those few for which not much progress has taken place. It is important to stress that all projects need some assistance from the stakeholders, and none should be complacent.

The Annexes reproduce the Terms of Reference of the Assessment Expert Group (Annex 1), the template of the AEG Questionnaire sent to the projects to collect the information (Annex 2) and the assessment methodology (Assessment Matrix) used throughout the process (Annex 3). A list of acronyms is given in Annex 4.

2 ASSESSMENT METHODOLOGY

2.1 A new method for assessing ESFRI projects

The AEG assessment exercise started by analysing different aspects of the research infrastructures included in the ESFRI roadmap with two main objectives, as per ToR:

- The objective of this group is not to assess the scientific merits of the projects, but to evaluate the financial and managerial maturity of thirty-five projects of the ESFRI Roadmap.
- The report on each individual project should clearly identify specific bottlenecks and make recommendations on how to best address them and indicate the feasibility of these projects being implemented by 2015.

Based on the results of this analysis it will be possible for the main stakeholders to assess progress towards the Innovation Union target of launching or completing the construction of 60 % of the ESFRI projects by 2015, and to assess the type and level of EU support, which could be dedicated to the ESFRI projects under Horizon 2020.

The assessment exercise has to be based on 'common rules' and should 'guarantee an impartial process' as well as to consider a set of elements, as listed below. Research infrastructure projects have different timelines and their inclusion in the ESFRI Roadmap has responded to scientific requirements and opportunities to begin with. The current assessment does not consider the scientific merit of these projects. Research infrastructures require significant investment at national and international levels. The investment for these projects is sometimes to the order of many millions, sometimes to the order of over a hundred million EUR for the construction phase, plus around ten per cent of the construction costs for their annual operational costs. The nature of distributed and centralised research infrastructures is different. Therefore, some *ad-hoc* considerations

on distributed research infrastructures at each stage of the project cycle need to be made before deciding if the project is ready or mature. Additionally, it is important to stress that the AEG Report and assessment should be seen as a snapshot at a certain point in time of the status of each research infrastructure, as reported in the answers to the AEG Questionnaire. It does not take into account further developments after the interviews with the project stakeholders (March 2013).

Against this background, the first preoccupation of the AEG was to ask whether readiness guidelines existed for the selection of research infrastructures to be included in the ESFRI Roadmap. In the absence of existing guidelines at European level for screening and monitoring the progress and maturity of research infrastructure projects, the AEG has developed an assessment methodology with elements common to already existing procedures (e.g. the UK Gateway process). This assessment methodology is suitable for an ex-post evaluation exercise, like the current one, but can also be used as a guideline for the conception, preparation, screening and monitoring of research infrastructures based on the defined milestones and achievements at each stage of the project preparation. By establishing an expected critical path for research infrastructures to mature financially and managerially, the management should be better able to handle the inherent uncertainty and risk of a big science facility. These guidelines can therefore help decisions on securing the necessary funds and commitments at each stage of the project.

The applied methodology capitalises on the recommendations of the Report ([8]) of the Expert Group on Cost Control and Management Issues of Global Research Infrastructures, and builds on the established best practices of project reviews at national and international levels. In the UK, for example, Gateway Reviews form a mainstay of the government assurance process for major projects. The UK Major Projects Authority Assurance states that, 'Gateway reviews deliver a peer review in which independent practitioners from outside the programme/project use their experience and expertise to examine the progress and likelihood of successful delivery of the programme or project. The review uses a series of interviews, documentation reviews and the teams experience to provide valuable additional perspectives on the issues facing the project team, and an external challenge to the robustness of plans and processes.' ([9])

The rationale of the assessment methodology developed by the AEG, defined through the Assessment Matrix, is that a research infrastructure, as any other publicly funded project, should start and progress according to a given schedule, be developed and completed within budget by using resources, both financial (national and EU funds) as well as human capital (including in-kind contributions), in an efficient and structured fashion, so as to deliver on its agreed long-term mission. Any funding decision on spending public funds should be based on solid preparations and a project plan with clear goals and well-defined milestones.

The AEG adopted the principle that a set of requirements at each stage of the preparation of the research infrastructure has to be successfully accomplished. The assessment methodology is an analytical framework to list and measure the requirements to be met by the project, before being considered mature or ready for sustainable operations. Only the top-level principles of managing a research infrastructure project successfully are listed in the Assessment Matrix, as it will be always left to the responsibility of the

8 http://ec.europa.eu/research/infrastructures/pdf/cost_control.pdf#view=fit&pagemode=none

9 (www.gov.uk/government/publications/major-projects-authority-assurance-toolkit).

project management to determine, in a bottom-up manner, the application of these principles to the specific science mission. Accordingly, the Assessment Matrix is structured in two key dimensions:

- Three main project phases: Preparatory, Approval and Implementation.
- A set of requirements grouped into modules covering the major aspects of the project planning and implementation: Cost and Financial Structure, Governance and Legal Structure, Stakeholder Engagement and Financial Commitments, HR Policy and Project Management, User Strategy and Risk.

The assessment process consisted of responses by the management of a research infrastructure to an AEG Questionnaire, supported by additional documentation and interviews in Brussels. This process enabled the AEG to benchmark each assessed project against the expected milestones at each stage of the project for each module.

This process can be used not only by external reviewers, but also by internal reviewers for each research infrastructure. Indeed, it is recommended that, together with the more traditional scientific and technical reviews, the project management verifies periodical progress using this methodology to ensure that the required financial and management conditions are met at the different stages of project evolution.

The next sections explain the key concepts of this assessment methodology, while the details are presented in Annex 2 (AEG Questionnaire) and Annex 3 (Assessment Matrix). A list of acronyms employed in the text is given in Annex 4.

2.2 The Assessment Matrix

The Assessment Matrix consists of six assessment modules on one axis and three phases on the other axis, in order to systematically analyse the development of a project, as described in Figure 1. Each phase comprised a set of stages.

PHASE	STAGES	MODULES					
1. Preparatory	Concept Screening						
	Feasibility Study						
2. Approval	Business case review						
	Delivery Strategy						
	Investment Decision						
3. Implementation	Construction						
	Operations						

Figure 1: Overview of the Assessment Matrix

The project main phases

The AEG defined three main phases in the development of a research infrastructure, each of which has a number of stages. A project needs to pass through a Preparatory Phase and an Approval Phase before moving to the Implementation Phase, which includes construction and operation. This phased approach is consistent with international best practices.

The three main phases are outlined below:

1. The **Preparatory Phase** includes the Concept Screening Stage of the scientific proposal and a Feasibility Study Stage, in which the soundness of the scientific and technological concepts are tested. This is a critical phase, where the research infrastructure needs to show its merit in terms of its science mission, but also the feasibility and value-addition. A first question in this phase is to identify the community of users and stakeholders as well as to undertake a gap analysis of the scientific landscape in terms of existing facilities (in an international perspective), user potential and the ability to move the scientific frontiers. This can help in reducing fragmentation, enhance efficient use of resources and most of all helps the management to focus the science mission on achieving excellent and unique results at the lowest cost. At the end of the Preparatory Phase it is recommended that the projects have an independent external review to check that all requirements are met. Only after this initial review, a project should be considered ready to be included on the Roadmap.

2. The **Approval Phase** involves the development and demonstration of financial support from the stakeholder community (Business Case Review Stage), an explanation of the strategy and an action plan for the delivery of the project's goals (Delivery Strategy Stage) and a careful preparation of the investment decisions (Investment Decision Stage). The decision to fund a new research infrastructure should be based on a technical and financial options analysis, which has balanced the benefits of creating a new facility, against the costs. This is the most delicate phase for a successful project, which requires the project management to convince the stakeholders and funders that the science case is worth being pursued and financed, as well as providing convincing proof that all the necessary project and human resources are in place to efficiently manage all aspects of the project, including access by users. This phase could take several years, as distinct work-packages have to be completed. Crucially during this phase, sufficient planning, detailed design and costing must be done to establish the confidence needed by the funding authorities to commit significant funds to the implementation of the Research Infrastructure. A set of independent reviews should be held at this stage.

3. The **Implementation Phase** requires that all conditions are in place to construct and operate the research infrastructure. A project ready for operation needs a well-structured and legally sound organisation, a clear policy for managing human resources, a competent project director and experts to manage the project's contracts (procurement task force). Moreover, since the research infrastructure has to rely on a constant stream of operational funds from the main stakeholders, it is vital that the project management defines KPIs with target values to justify the request for operation funds. The users should be able to rely on a well-defined user strategy, which lists the conditions for accessing the data (ideally as open access). However, since facilities in general also contract with private partners, an Intellectual Property Rights (IPRs) policy should be also in place.

These concepts are not new. They already exist in many national funding agencies. The critical step forwards has been to use this assessment methodology at European level. Indeed, if a research infrastructure is included in the ESFRI Roadmap, which has a European strategic dimension, in principle it should meet not only the national selection criteria, but also take into account the European dimension.

The Project Modules

The Assessment Matrix is structured according to six modules, as presented in Figure 2. A well-structured research infrastructure project has to be appropriately mature at each stage of its life in each of these six areas.

MODULES
Cost and financial Structure
Governance and Legal Structure
HR Policy and Project Management
Stakeholder Engagement and Financial Commitments
User Strategy
Risk Strategy

Figure 2: Modules of Research Infrastructures

1. The **Costs and Financial Structure** should be clearly spelled out, with a different degree of accuracy on cost estimates depending on the project phase. A progressively well-defined financial plan including costs, but also financial commitments, both in cash and in-kind with clear assumptions, based on the results of work-packages, is necessary at each project stage. The way in-kind contributions and cash requirements are calculated should be transparent. The financial plan should be ready to be submitted to independent reviews at any stage of the project. While it is natural that cost estimates improve over time, as a result of a more detailed engineering design, even initial cost estimates should provide the order of magnitude of the investments required, as well as the level of confidence of these estimates. For a distributed infrastructure, the financial plan should also separate the capital and operational costs which are purely relevant for the 'national nodes', from the investment and costs that exclusively relate to the 'central hub' and have a pan-European dimension. Also in the financial plan the use of different types of funds should be clearly identified. The funds might include national funds and EU funds (which include both European Regional Structural Funds, ERDF and Research Funds, from the 7th Framework Programme or Horizon 2020). Whilst the costs and level of commitment from potential funders will reach higher precision and certainty as the project develops towards implementation, there needs to be an understanding of both at all stages.

2. The **Governance and Legal Structure** has to be in place for a research infrastructure to organise itself as a project capable of attracting resources. A legal structure is, in many instances, the prerequisite for different research institutes in different nations to get together. This legal structure constitutes the platform for securing the rights and the responsibilities of all different national partners and, where appropriate, national and international stakeholders. Adequate decision-making bodies with an appropriate degree of autonomy and authority should be appointed with sufficient power to

make decisions in the Implementation Phase. The statutes should be discussed in depth by all shareholders looking at the practical implications of decision-making, before legal stamps are put on it. Often ethical issues are of critical importance for research infrastructures to relate to the public, to regulatory authorities and to stakeholders. An Ethical Committee should be established for dealing with the social responsibility issues of these complex research public projects. Governance and legal structures need to be adapted and validated in practice at each project stage.

3. **HR policy and Project Management**. A research infrastructure project should have clearly defined goals, a strategy on how to achieve such goals, a quantitative way to measure progress and degree of success in the different phases of the project. Unless the research infrastructure has a clear staffing plan and an effective recruitment strategy, it is unlikely to attract the necessary human resources required to achieve its goals. The project requires an organisational chart and a process flow, with clear roles and reporting lines, on how the different lines of management interact at national and international levels. Again, the requirements differ at each project phase. Even before construction begins, a suitable project organisation needs to be operational to manage the strategic oversight of the investments and the procurement of the contracts. Managers should develop operational plans with schedules on how resources are deployed to reach critical milestones and results. Unless a work breakdown structure (WBS) is developed specifying who-will-do-what and suitable intermediate milestones are identified for distributed as well as for single-site infrastructures, it is unlikely that progress will be measurable. KPIs should be identified with target values for what constitutes the quantitative measure of success in the different phases of the project. For a major research infrastructure, it is recommended to appoint a procurement task force, with international experts included, with track record to manage the procurement process in the case of efforts that involve procurement at different national nodes and/or in-kind. Lack of experience in launching international calls for tenders for complex technical contracts, the legal and technical implications, combined with the stringent time limitations connected with some financing sources involved, are often among the main challenges.

4. **Stakeholder Engagement and Financial Commitments**. Identification and the subsequent engagement of stakeholders should be done early in the conceptualisation. The commitments of the institutions behind the scientists who initiate the project are crucial because ultimately research infrastructures should be embedded in institutions. From the start they should be involved in the project development. Stakeholders from the funding side (governments, research councils, EC, private sector) are obviously important for funding the construction and operations. It is important to engage them early in the project development. Especially the engagement of governments is both essential and often complex. Essential because including the project on national and ESFRI Roadmaps often is a condition for receiving funding. Complex because in different countries the processes for accessing the various government levels are different. This should be made a specific work-package in the project development, requiring high-level leadership with the right competences. The users, both from the scientific community, the private sector and public policy sectors, are the ultimate target for a new research infrastructure. Their commitment helps build the construction case. An Engagement Strategy document should be prepared to explain the objectives of the research infrastructure and why it needs public funds. If relevant, this document should clearly present the societal challenges the project is addressing, the economic and social implications of not addressing them, as well as providing convincing arguments for committing public funds in the development of its science mission. Part of this Engage-

ment Strategy should also be dedicated to qualitatively and quantitatively explaining the cost for Europe of not having a research infrastructure in that particular field.

5. **User strategy**. By definition, a research infrastructure should be orientated at serving the needs of its users. If there are no users, or if these are not well identified, the project has no '*raison d'être*'. The way the research community and the private users engage with the project is a vital element for its success. Users should be identified and contacted before a major investment is committed. If the research infrastructure has a wide user community, without a sufficient and well-developed User Strategy document, including the policy for data access, the pricing mechanisms for private users if applicable, the protocols for data integrity and templates for how Intellectual Property Rights (IPR) are addressed, the research infrastructure cannot be considered ready for implementation. The different users should be clearly identified, quantified, and their needs clearly listed. A User Strategy Document should be updated with increasing accuracy during the maturity process of a research infrastructure.

6. **Risk strategy**. To avoid costly miscalculations, mitigation strategies in the form of different scenarios, including multiple financial and technical options, should be elaborated. Who is in charge should something go wrong should also be listed. The research infrastructure should be able to rely on a well-defined track to reduce and manage all the risks linked to this inherent uncertainty. Risk considerations and evaluation are an essential part of each one of the five 'modules' explained above. Risks should be managed carefully at each project stage, to avoid surprises and unexpected cost escalations. Professional cost engineering procedures should be used and contingencies appropriate to the carefully evaluated risk should be planned to ensure effective and timely management of potential emergencies or cost overruns. Technical risks should be identified and mitigated as carefully as possible. A risk register appropriate to the project should be developed as soon as possible and updated regularly. Currently the exercise of developing such a register is extremely useful und helps the scientists to better understand the paths and procedures to be followed.

The AEG has identified for each module, with the exception of the risk module, the critical requirements that should be met by each research infrastructure to deliver on its scientific objectives. The list of all expected requirements is presented in Annex 3. It is not exhaustive, but it is nevertheless useful to provide sufficient safety nets for facilities to be able to withstand different internal and external pressures and respond in convincing ways to the many questions, that the stakeholder and user community will legitimately pose, during the research infrastructure's development. This list was not developed for the risk assessment, because risk is extremely specific to the infrastructure and its field of science, hence criteria on risk, valid for all, would be too general to be meaningful.

For the purpose of the AEG Report, a research infrastructure is considered to be 'mature', i.e. ready for implementation, when it meets the main milestones:

- Cost and financial plan are well defined, with adequate cost estimates;
- Firm financial commitments for the relevant investments and operations;
- Approved statutes and governance structure are in place;
- Existence of a credible project organisation, with clearly identified responsibilities and reporting lines;
- KPIs are established and staff planning outlined, including procurement considerations;
- User strategy is well planned;
- Risk analysis is included.

The assessment methodology (and associated matrix) has been applied in a two-step process:

- An AEG Questionnaire was formulated, with questions sufficiently generic to allow different answers and enable the research infrastructure team to provide an in-depth overview on the status of the project, and its challenges.
- A two-hour Interview was organised to enable each research infrastructure team to present the project, explain its progress and discuss the hurdles towards implementation.

The AEG Questionnaire is appended in Annex 2. The questions were aimed at understanding not only the status of the research infrastructure project, but also the factors impeding the project's development. The answers to the AEG Questionnaire and to the questions asked during the Interview have identified some general issues on why many teams are facing difficulties.

A major methodological difficulty occurred when assessing distributed research infrastructures. Major investments are being made at national level, so for distributed research infrastructures, the central hub, or the European dimension of the project is usually relatively small in financial terms, compared with the national main components. A trade-off often exists between the desire of the national node(s) to 'control' the national investment and the overall objective of the research infrastructure and the optimal use of national resources at European level. The delicate relationship between the national nodes and the central hub has to be better defined, in a way to outline the perimeter of the research infrastructure and its success. Without these boundaries being well defined at European level, it is difficult to speak about European research infrastructures, instead of a network of national nodes.

It should be noted that in the presence of strong national nodes for distributed research infrastructures, the overall importance of the national entities could be higher than the central structure. While the statutes tend to define in theory this complex relationship, the effective working relationship in practice between the central and national entities has often not been worked out or fully recognised. It is also a matter of people dynamics and of well-defined procedures at the service and working levels on who-does-what and who-is-responsible-for-what. There are significant differences and a full generalisation is not possible.

Chapter 4 will concentrate on general conclusions on the status of research infrastructures and general issues for each module. Here, a preliminary methodological recommendation is made to reinforce the coherence and synergy amongst projects. For most of the ESFRI research infrastructures, as Chapter 3 highlights, the main difficulty originates in moving from a Preparatory Phase project funded under the 7th Framework Programme (FP7) to a well-structured research infrastructure organised as a project capable of receiving the additional national funding and employing human resources effectively at European scale, or the development of a complex project within schedule and budget, possessing financial and managerial maturity. The transition is not only a matter of size, but also of scope. The genesis of a project is not linear, but dynamic and crucially depends on the 'project competence' of the research infrastructure team to engage in a truly European undertaking. The evolution from a network of research organisations or national nodes to a pan-European research entity has to be facilitated by a set of detailed guidelines, which could set the European dimension for research infrastructure development.

The AEG therefore recommends that the methodology used for the present assessment is further developed and validated to constitute a useful tool for the preparation and deployment of new research infrastructures of pan-European interest.

3 KEY FINDINGS AND RECOMMENDATIONS FOR EACH RESEARCH INFRASTRUCTURE

This section contains the assessments for the individual projects, divided by scientific field as in the ESFRI Roadmap and listed in alphabetical order within each field. It is important to stress that all information (including figures, dates, deadlines etc.) quoted in the individual assessments is related to the end of the last round of interviews, i.e. end of March 2013. Due to the rapid progress of some projects, some of these figures and data may be obsolete by the time this report is published.

In case conflicts of interest were identified, the concerned experts(s) did not participate either in the interview or subsequently in the assessment.

3.1 Social Sciences and Humanities

CLARIN — Research Infrastructure to make language resources and technology available and useful to scholars of all disciplines

Key issues and findings

CLARIN has been on the ESFRI roadmap since 2006 and in February 2012 was approved as an ERIC. CLARIN's vision is to create a sustainable infrastructure that will provide the Humanities and Social Sciences with easy and lasting access to existing and future language resources and state-of-the-art tools. CLARIN is an ERIC with 9 signatories at this point: Austria, Bulgaria, Czech Republic, Denmark, Germany, Estonia, Netherlands, Poland and the Dutch Language Union.

Processing language resources: from authorship to scientific publications using the CLARIN research infrastructure for processing and analysing data in the humanities and social sciences. © CLARIN

The overall evaluation of CLARIN indicates that issues of finance, governance, management, stakeholders, user strategy and risks are addressed in a rather sketchy manner. From the point of view of finance, there does not appear to be a cost breakdown for the central functions. The activities are adjusted to fit the budget: currently the central budget is EUR 0.6 million with a target of EUR 1 million. More contributions from additional partners would enable more central activity. There is also no pre-defined work-breakdown structure for the in-kind contributions. Lack of central funding limits control over what work is done by the individual partners.

A central fund to enable the commissioning of key work packages would be a very positive step if the funding partners could agree to it. If additional funding were available to commission additional work, then further steps in building up a knowledge-sharing infrastructure could be achieved. This would enable the development of search software and content search across the countries and repositories. There also seems to be a great deal of uncertainty about the future funding of the project, both in terms of commitments and the funding model. Accounting and auditing via the University of Utrecht has been specified through an agreement.

The Governance structures can be said to be fluid, especially with respect to responsibility, which is not clearly specified or developed in the statutes, notably with reference to the specific responsibilities of the governance bodies envisaged. At present, the General Assembly has overarching 'power' in all domains of activity and its relationship to the Standing Committees is not clear. Also, the ERIC statutes contain general statements about best practices in recruiting and procurements, but no specifics are given.

No central budget for construction and operations has been envisaged. Construction of national nodes is the responsibility of individual countries, thus the formal role of the central structure is not visible enough. Contributions are not jointly decided, but left to individual countries. At the same time, no contractual relationships between the central facility with the national nodes are specified. The contribution of the national nodes, in principle, relies on the efforts of coordinators. The question that follows is, how does the central facility enforce compliance with the CLARIN standards? This remains unclear.

Only 9 out of potentially 28 countries signed the ERIC and committed financially. It is undefined whether there is a real awareness of the socioeconomic benefits at governmental level. Special effort should be put into attracting more countries. For a research infrastructure primarily focused on language resources, 9 out of 28 countries is not sufficient and the aim should be to include all EU members. No private sector engagement has been considered so far. Funding issues can be considered to be the biggest obstacle.

There is a good risk analysis at the higher level of activities of CLARIN, and proper mitigation strategies.

Recommendations

- The project should develop a cost breakdown of the central activities with an indication of the additional activities that could be provided if more funding was made available. The creation of a central fund to enable commissioning of additional research infrastructure elements should be considered.
- Transform the engagement with (financial) stakeholders, especially governments and research councils, into a professionally managed project during the construction phase.
- A strategy for bringing on more countries should be developed. Development of credible KPIs is urgent and an essential element in convincing other stakeholders to commit.
- A reasonable activity/implementation plan specifying the roles of the different partners should be developed. In particular, an agreed work-breakdown structure for the in-kind contributions should be developed and a gap analysis performed to identify missing research infrastructure elements.
- Strengthening the role of the central node (e.g. in setting standards and enforcing them) and developing service level agreements with national nodes will increase the relevance, the visibility and the impact of CLARIN as a European infrastructure.
- Responsibility in the sense of who is responsible for what in the different bodies should be more clearly defined. Governance means responsibility and this is not clearly spelled out in the documents. In this sense, the mission of the Standing Committees should be clarified and their relation to other governance bodies should be clearly explained.
- The General Assembly has overarching powers and, in the future, a governance model considering other alternatives should be developed.
- An ethical body should be envisaged in the future.
- The checks and balance system should also be precisely stated.
- A reasonable HR policy for the national CLARIN consortia and centres specifying the required competences could complement the minimum toolkit.
- Commitment from the scientific community outside of linguistics should be made stronger. This is an area that should be prioritised and worked on, for example, by developing organised outreach and demonstration projects to engage other user groups.

- Once a reasonable activity/implementation plan is developed with an appropriate WBS and financial plan, both should be subject to the appropriate independent (external) reviews.
- The relationship with DARIAH should be investigated and possibly closer relationships could be established.
- Standards and well-defined data access policy should be developed. Problems of data protection, privacy violation and IPR infringements could also present risks and should be addressed.
- Risks analysis and management should be developed further. Risks outside the competence of the Humanities — risks related to the e-infrastructure (servers crashing, virus infection, hacking and data theft, falsification and data integrity, introduction of ethically and personally offending papers, contract with providers) should be elaborated more explicitly.

Conclusions

CLARIN has been on the ESFRI Roadmap since 2006 and in 2012 was approved as an ERIC. However, issues pertaining to finance, governance, stakeholder commitment, management, user strategy and risk mitigation at all levels are still in many respects undefined, and need further development. Developments in all the areas listed should be checked for progress.

CLARIN at this stage has not yet reached maturity and in order to be ready for implementation by 2015, concentrated, focused efforts have to be undertaken and the AEG's recommendations should be followed.

DARIAH — Digital Infrastructure to study source materials in cultural heritage institutions

Key issues and findings

DARIAH-EU supporting digitally-enabled research in the humanities and arts

DARIAH was included on the ESFRI Roadmap in 2006. From 2008 to 2011, DARIAH was in the Preparatory Phase and from 2011 to 2013 it has moved on to the transition phase, establishing the DARIAH-ERIC with the mission of integrating national activities. So far, 11 countries have signed the Memoranda of Understanding (MoUs): Austria, Croatia, Denmark, France, Germany, Greece, Ireland, Luxembourg, Netherlands, Slovenia and Serbia. DARIAH sees itself as representing a part of the digital revolution in the Arts and the Humanities, with the specific aim of helping research communities to deal with the digital deluge, and the move from 'traditional' to 'digital'.

So far, secure and long-standing financial commitments from the major countries (France, Germany, Austria, Netherlands, Luxembourg and Ireland, accounting for the EUR 4 million budget), have been received, while discussions are reportedly also taking place with other countries, including with Croatia and the UK.

There are no central development activities, only in-kind contributions. All the development activities are carried out in the national centres (Virtual Competency Centres — VCC). The focus is now reportedly on building up the national strengths. A delicate balance manifests itself between the top-down and bottom-up approaches. A year after the start of the ERIC, the project is reportedly planning to implement a more coordinated central effort.

The central budget proposal, EUR 0.4 million, covers coordination and travel and other costs. The proposed in-kind contributions of EUR 3.6 million are planned. There is limited clarity about the ERIC funding and the role of the central hub in view of the present bottom-up, grassroots approach and the limited impact on the national decisions about funding and investments. No project-wide KPIs have been developed.

The ERIC statutes contain general statements in places, which, in some cases, do not clearly outline responsibilities and procedures. The statutes, for example, contain general statements about best practices in recruiting and procurements, but no specifics are given. It is unclear who will be doing the recruiting, procurement, spending, etc.

A Virtual Coordination Office is envisaged having a very small cash budget, while in-kind funding is relatively large. Having a Chief Integration Officer seems to be a good idea, considering the nature of the relationships involved.

The VCC Advocacy is responsible for the engagement strategy with governments. This is dealt with at the top level in DARIAH. There have been some considerations of engaging the private sector, however, none for engaging semi-public entities. Procedures for regis-

tering the users of DARIAH have not been developed. There appear to be no restrictions on access to DARIAH. Users are required to deposit data and publications, although it is not always clear how this is to be achieved and the Statutes are vague in this respect. The decisions on user access and fees seem to be in the hands of the General Assembly. A further refinement of the Governance could handle this issue.

There is a good risk analysis at the higher level of activities of DARIAH and proper mitigation strategies at this level are drafted. Other risks, related to the e-infrastructure (server crashing, virus infection, hacking and data theft data, falsification and integrity of data, introduction of ethically or personally offending items) are not mentioned.

Recommendations

- Considering the importance of bringing on as many countries as possible, a well-developed strategy for this should be articulated.
- The strengthening of the top-down and the bottom-up coordination should clarify how DARIAH will function in the Implementation Phase. It is important to ensure that the top-down analysis of what would ideally be needed and the decisions on bottom-up contributions are brought into line as soon as possible to ensure that resources are matched to the work programme.
- A reasonable activity/implementation plan specifying the roles of the different partners should be developed. In particular, the project should outline an agreed work-breakdown structure for the in-kind contributions and should consider a gap analysis to indicate where missing research infrastructure elements (data and services) would be welcome. The creation of a central fund to enable the commissioning of additional research infrastructure elements should be considered. The ERIC 'breathing space' should be used to develop activity and financial plans that could withstand external audits.
- Further refinement of governance structures is needed. The General Assembly is the major decision-making body on all issues. There is no Finance Committee mentioned, possibly in future this should be addressed, as well as the possibility of other governing bodies.
- An Ethical Board should be considered in future developments.
- The relationship with CLARIN should be investigated and possibly closer relationships could be established.
- Developing convincing and measurable KPIs is urgent and cannot wait for three years. These may include KPIs for science, users and industrial applications.
- Strengthening the role of the central hub (e.g. in setting standards and enforcing them) and developing service level agreements with national nodes will increase the relevance, the visibility and the impact of DARIAH as a European infrastructure.
- A User Strategy for engaging private sector parties such as Google and semi-public entities should be considered.
- An analysis of the user community and its possible overlap with other projects should be performed.
- Develop joint standards and access models for the different VCC.
- The Risk Analysis should be developed further. Problems connected to data protection, privacy violation and IPR infringements could also present risks and should be addressed.

Conclusions

DARIAH has not yet reached maturity, although during its life span from its appearance on the ESFRI roadmap in 2006 steps forward in setting up a European research infrastructure are evident.

The main focus of future activities should be on strengthening and developing the top-down and bottom-up coordination in the spheres of finance, governance, stakeholder engagement, management issues, user strategies and the further development of risk mitigation. DARIAH at this stage has not yet reached maturity and in order to be ready for implementation by 2015, concentrated, focused efforts have to be undertaken and AEG's recommendations followed.

COPAL — Long range aircraft for tropospheric research

Key issues and findings


With the permission of Lockheed Martin

COPAL has been on the ESFRI roadmap since 2006. The original target of raising support to implement a heavy-payload, long-endurance, instrumented aircraft for tropospheric research in environmental and geo-sciences has not materialised as planned, despite the potential impact of the initiative on important research areas such as atmospheric dynamics, aerosol chemistry and physics, cloud physics, gas chemistry, precipitation, pollution, soil-atmosphere interactions, ocean-atmosphere interactions, urban studies, marine science, biology and ecology, glaciology, agriculture, forest fire, volcanology, hydrology, archaeology and gravimetry.

COPAL attributes the limited results in raising the necessary funding to start the construction to four main issues:

- Lack of experience in designing large-scale research projects in Europe;
- Insufficient commitments from national research funding institutions in the project;
- A limited user base in countries with no research aircraft;
- Inconvenient timing of the project since the three major operators had just completed substantial investments in the year 2000.

The proposers explained that Germany was not interested in collaborating because it has its own funding and its Gulfstream 550 has enough endurance to fly the required long-distance routes, and that France and the UK tried to collaborate on a C-130 option, but the time was not right for any collaboration. During the interview, the management explained that the situation may evolve after 2015 when the UK and France will start planning the renewal of their fleet.

Added to the above four factors is a substantial delay in entering into discussions with Airbus to explore the creation of a public-private partnership. One further specific issue for COPAL was the operation of a Community aircraft since there is no EU flagship for aircraft registration.

The new target of renting flight time from Airbus and participating as a COPAL legal entity in EUFAR still needs to be thought out. COPAL would be a member of EUFAR, as a single-site infrastructure operating a plane jointly loaned by the COPAL partners. The managers maintain that the availability of the Airbus 400 (37 ton payload) for 100 FH/yr will free spare capacity on the other planes and justify peer-reviewed open-access policy within EUFAR. It may be noted that running an operational aircraft or just offering peer-reviewed open access to existing national aircraft are very different activities.

The governance structure is still under discussion, thus statutes are not ready. The legal structure has not yet been selected and even the selection of options is still ongoing, although the general consensus is to consider the AISBL model, which seems more practical to implement in the short term. The MoU contains no legally binding commitments and no contributions have been agreed upon.

The management has gained experience during 12 years of reporting EUFAR activities to the European Commission. EUFAR-I3 2004-2012 involved a network of aircraft operators. Germany, the UK and France account for almost all of the work/publications. A similar process would be implemented for the EUFAR-COPAL project, in which each activity achievement would be monitored, KPIs documented and annual reports produced to be evaluated by the Council and the Scientific Advisory Committee. Today 27 European operators of airborne facilities for atmospheric research and hyperspectral observation of the Earth surface actively contribute to EUFAR, serving 42 airborne facilities, among which 24 are open to transnational access during the 6th Framework Programme (FP6) and FP7, EUFAR has supported 82 transnational access projects, 7 training courses on airborne research and 31 expert workshops.

Considering that the main obstacle to peer-reviewed open access is the high additional cost of the flight experiments, COPAL and EUFAR have jointly developed a peer-reviewed open-access scheme, in which access to a research aircraft is funded by means of in-kind contributions of resources such as trained instrumentation or technical staff. National research organisations will implement peer-reviewed open access to existing facilities, hence expanding and consolidating the scientific user base. Within that structure, they will continue jointly to evaluate various options for providing the European research community with access to long-range aircraft by sharing test aircraft with industry.

If limited to the implementation of peer-reviewed open access, the performance indicator will be the number of new scientific users from non-operating countries getting access to the existing infrastructures, the number of flight hours gained and, in the longer term, the number of peer-reviewed publications produced by these beneficiaries. If extended to networking activities, performance indicators will be those already in place in EUFAR, such as number of Expert Working Group meetings, training courses, number of students trained, etc. The project manager, with the support of the assistant will be responsible for monitoring the activities to report to the council.

The main risk appears to be the difficulty of obtaining the necessary support in a still small user community. Although COPAL and IAGOS have complementary targets, the only mention of IAGOS in the information provided concerns the selection of the AISBL institutional model.

Recommendations

- Raising the estimated EUR 60-120 million required for purchase and conversion of a C130 or Airbus 400M plane does not appear achievable at this time. A new proposal has emerged, to share use of an Airbus 400M with industry at an estimated cost of EUR 3-10 million. But there is not yet a clear work plan with milestones for such a major redirection of the project. A Feasibility Study analysing the different technical options is recommended. Major stakeholders' efforts should be focused on exploring and then developing the option of shared access to an Airbus 400M. A detailed costing should be developed for this option as well as cost-sharing models, including public-private partnership. If all this materialises, a new project definition, implemen-

tation plan, relevant KPIs and budget planning should be developed and submitted for external review.

- If the option of a public-private partnership with Airbus is selected a new mechanism for funding this new venture should be explored, also including long-term loan financing and private equity. Together with Airbus and relying on Airbus's business concepts, Delivery and Investment Strategies should be elaborated.
- The additional COPAL-EUFAR open-access scheme cannot be considered a traditional research infrastructure. An analysis of the value added by the new research infrastructure should be performed and the role of the central structure better defined.
- The promising new emphasis on involving new EU member countries through access to structural funds would need to be explored in detail and a suitable implementation strategy defined.
- A step-by-step development of governance and legal structures should be undertaken, adapting the legal structure and decision-making process to the new operational requirements if the public-private partnership with Airbus is going to develop. A Board involving members of Airbus could be a measure to catalyse the focus and funding requirements of the research infrastructure. Since the time left in the Preparatory Phase is limited, the management should make these issues a priority.
- The management should ensure that it has the management capabilities for bringing together the initial science mission of COPAL and the forward-looking industrial vision of developing new technologies for critical aircraft-based measurements related to climate change.
- As part of any new plan there should be a proper survey of the user community interest, including funding support for the utilisation by funding agencies. A gap analysis should be undertaken to identify potential users of any new technologies, in the EU and outside the EU, as well as to estimate the potential market for these new technologies. Suitable KPIs for the user programme should then be defined.
- In the new design the relationship to ICOS and IAGOS should be addressed. It may be worth thinking about a joint venture with IAGOS, attracting further users, thus increasing the number of stakeholders making possible the financing of the aircraft. In any case, sharing technical know-how and operational experience could benefit both research infrastructures.

Conclusions

COPAL is in flux and its scope has dramatically changed in relation to the original plan of procuring a dedicated aircraft (C130 or Airbus 400M), which has failed. A completely different plan is being explored, with a number of new potentially interesting ideas being developed, including a partnership with Airbus and the use of structural funds.

But the new research infrastructure, which would need a new independent evaluation, has clearly not yet reached maturity and the chances of achieving readiness for implementation by 2015 are considered minimal at this stage.

EISCAT_3D Upgrade — Upgrade of the EISCAT Facility for Ionospheric and Space Weather Research

Key issues and findings

The existing EISCAT facility has been operating successfully for over 30 years. EISCAT-3D has been on the ESFRI Roadmap since 2008 and the Preparatory Phase started in 2010. The goals of the proposed infrastructure are to upgrade the antennas and expand the user community. The focus is to study plasma density, electron and ion temperature, ion velocity and arctic ionosphere coupling with atmosphere at the transition from space to atmosphere (60 to 1200 km altitude) and help understand how the sun influences the Earth.

Cost estimates for constructing the new infrastructure are around EUR 135 million, including EUR 12 million of contingency. Operating costs are estimated at EUR 9 million per year, compared with EUR 3.7 million per year for the current operations. All of the current EISCAT Associates (China, Finland, Japan, Norway, Sweden and the United Kingdom) have indicated their support for the new system. There are investment proposals to the three host countries (Sweden, Norway and Finland) equivalent to EUR 80 million, while Japan will decide soon about a possible EUR 15 million contribution. The UK might also contribute, but there is no commitment at this point. There is some uncertainty with the costing, because it will depend on the site selection, which has not yet been finalised; using existing sites would be cheaper at the beginning, but more expensive in the long run due to maintenance.

Primarily from a managerial point of view EISCAT-3D is an upgrade of the existing facility, but the current plan is to maintain much of the current facility throughout the construction of the upgrade, so there will be no abrupt shutdown of the existing facility. The new functionality will imply that few users will want to use the old facility once the upgrade is complete. There is a need for clarity on the issue of whether EISCAT-3D is an upgrade or replacement of the existing EISCAT facility. During the Preparatory Phase the permanent technical staff has not been involved other than as advisors, and has been fully committed to running the present infrastructure. While the upgrade needs to be managed as a separate project there needs to be an integrated plan including funding and staffing for the existing facilities and the upgrade programme.

The EISCAT organisation has a very good track record running the existing facility and the new management seems qualified to enact such an ambitious upgrade programme. But the scope of the project has not yet been defined, and the available financial support is still to be agreed. It appears that a staffing plan has not yet been developed

and KPIs for the project as a whole (also taking into account societal impact) are not available.

In-kind contributions are expected, but at the moment the proposers have not yet planned contractual agreements to ensure that critical items are delivered on time and on budget. A procurement panel to follow project-wide procurement has not been planned but a committee has been established by the Council to study how possible in-kind contributions (buildings, land, etc., not the system itself) should be treated.

No costs associated with frequency protection are expected. For Norway, there are only laws about frequency for transmitters but EISCAT-3D needs to use the transmitting frequency within one year or lose it.

EISCAT has a well-developed governance structure that is simple and has obviously proven effective. The question is what would be the advantage of setting up a new legal structure instead of developing this one further. It is not clear, for example, how they would benefit from an ERIC.

There is a well-established user community primarily from academia. The strategy for engaging new users is to offer data to new user communities quickly. The hope is that this also helps influence funders. In terms of relationships with industry, the role of the private sector, other than as a supplier, is not clear. Engaging the private sector at an early stage is important in this field. Also the relationship with SKA and LOFAR could be developed. The overlap lays not so much in the type of data, but in the competition for skills and relationships with suppliers. IPR-related questions with respect to data access have not occurred in the present instruments. EISCAT-3D maintains a good training and teaching programme for the users.

Consideration has been given to the project risks, though no special technology risks are mentioned. However, the requirement to minimise energy usage could present unexpected problems and a risk assessment should be prepared in due time for these technologies.

Recommendations

- EISCAT needs to continue discussion on financial commitment. Well-defined Delivery and Investment strategies, illustrating the transition from the existing to the upgraded infrastructure and the commitments, should be prepared as an aid to these discussions.
- The EISCAT organisation and the new management seem qualified to enact an upgrade programme. However, they need to move quickly to define the scope of the project based on the financial contributions. A schedule for such a project definition seems urgent and essential.
- It seems important to reach decisions on the sites as soon as possible and to seriously consider the option and timing of ceasing operations of the existing facilities in order to be able to present robust cost options to the funding agencies.
- Although there will probably be no major issues, it is important to ensure that frequency protection is in place before committing significant capital spend.
- Because of impact on environment, as well as data issues, an Ethical Board dealing with social responsibility issues and data integrity reporting on sensitive issues should be established by the Council as a separate entity.

- Contractual agreements and a committee or Project Office with real powers are needed to ensure that items to be delivered by partner institutions will be procured and supplied on time and on budget. Care should be taken to minimise the cost increase that may come from splitting the planned project procurement in the work-packages allocated to individual national or institutional contracts.
- A staffing plan should be developed detailing how many Full Time Equivalents (FTEs) will be required from the different project work-packages. Moreover, milestones should be set, identifying the hiring needs required to complement the staff committed by the different institutions. Hiring in competition with projects like LOFAR and SKA could be a challenge.
- The hiring, procuring and spending related to the different participating institutions, especially in-kind, should be monitored by the project office/management and interface documents should be developed to make sure that the items are delivered on time and on budget.
- KPIs should take into account technical, financial and social accountability aspects. They will help to maintain the project's direction and provide a tool to help persuade funding agencies and prospective new partners.
- Once KPIs are identified to monitor and assess project success, it will be important to perform credible external reviews of the technical, financial and recruiting-related aspects of the project. This might be complicated in view of the network character of the project, but internal boards are not enough.
- The Council which meets only twice per year will need to delegate enough power to the project management to be able to address project-related issues and changes in a timely manner.

Conclusions

EISCAT-3D is best seen as a major upgrade of an existing and very successful infrastructure. Many aspects of the planning for the proposed upgrade are nearing maturity though there is a need to clarify the scope of the upgrade and its relationship with the existing EISCAT facility. The funding for investment in the upgrade and for the increased operating costs needs to be determined as a matter of urgency and the scope of the project adjusted accordingly.

As currently defined, the research infrastructure is near to maturity and with additional efforts should be in a position to be ready for implementation by 2015, if the funding can be secured and if the AEG's recommendations are followed.

EMSO — Multisciplinary Seafloor Observatory

Key issues and findings

The EMSO research infrastructure builds on the European Seas Observatory NETwork Network of Excellence (ESONET NoE), networking a number of pre-existing and planned fixed sea floor observatories. Internationally EMSO considers itself partner with OOI, NEPTUNE and DONET. A Fix03 proposal was recently submitted for FP7 funding. EMSO has been on the ESFRI Roadmap since 2006. The EC funded Preparatory Phase started in 2008. There is no co-funding of the Preparatory Phase from governments, just institutional in-kind effort.

The sites to be connected are a collection of different installations with seemingly very different missions, from climate and ecology to earthquake, environmental and oceanographic research and monitoring. The research infrastructure maintains in its scope the different observatories with an estimated EUR 300 million in construction costs and EUR 40 million per year in operating costs. The prospects of getting these funds and what the value added of EMSO will be in terms of investment planning are not yet clear. EUR 83 million are claimed to have been invested (or are planned) in 2008-2013 on nine sites. The influence of EMSO on the investment decisions needs to be demonstrated. EMSO will stimulate the generation of a three-year construction plan that will be periodically updated and populated.

There seems to be a reluctance to create a strong central hub. The total management cost of the ERIC at year three will be just EUR 0.5 million per year, with a major part coming from Italy and smaller contributions from the other countries. Italy has committed funding for the first three years, with fixed fees from the other full members of EUR 15-35 thousand per year and lower amounts for the observers. There are no long-term commitments yet. The core budget looks small compared to the ambitions,

Map of EMSO Observatories

but they plan to leverage Horizon 2020 funding and national R & D projects. Co-funding from Europe and USA for joint ocean observation programmes will also be explored. The overview of secured ERIC funding was provided in response to the AEG Questionnaire, but it is not clear whether this is for the ERIC or for national facilities.

As a first step towards an ERIC, an MoU was signed in December 2012 by seven countries (Italy, UK, Ireland, the Netherlands, Portugal, Greece and Romania). Three additional countries were expected to sign by the beginning of 2013. Statutes have been discussed with ministry leaders and sent to them for a legal opinion.

Core activities will be the central procurement of the infrastructures, whilst the operating costs will be carried by the individual nodes. Coordinating ship time is an important aspect.

In terms of a gap analysis, the Member States have already selected the most relevant sites. Perhaps in the future new deep ocean Atlantic sites will need to be identified. It typically takes seven years to select a new site, such as the new Arctic site, where Germany and Norway have their own systems. EMSO stated that it might play a role in managing Structural Fund applications including different national partners.

KPIs to monitor productivity have recently been proposed for sites, agreements, data access and quality of papers and experimental applications, but target values for the project are not available.

The current work breakdown structure is purely an institutional construction effort. It will be mostly a task of the Director-General, in collaboration with the Executive Board members, to scout for opportunities to facilitate the participation of EMSO-ERIC in projects funded by public sources. Horizon 2020 is expected to be an important funding tool towards this end.

There are relations to the ESFRI research infrastructures SIOS, EURO-ARGO, ICOS, EPOS and KM3NET that could be developed and formalised.

EMSO seems to have a well-established user community that appears to be primarily European in origin. A data policy is foreseen based on open access. A single entry portal allowing all users to access all data from a distributed data archive is foreseen. Archiving and new tools development will be organised centrally. The ambition of EMSO is to have standards for the technology, benchmarked at the international level and accepted by the different funding agencies. KPIs dealing with users are in place.

Lack of continuity of financing is considered as the greatest risk. Recruiting risks are not mentioned. The draft statutes would present a serious risk for the Director-General because his decision powers are quite limited (see Article 15.2 and Article 16.6 of the statutes). Technical risks are reported. A final sentence refers to the technical risks associated with energy requirements of the observatories and the long-term protection of sensors.

Recommendations

- In order to qualify as an integrated European research infrastructure (over and above a networking and access programme), service level agreements need to be negotiated

with the national nodes, allowing EMSO for example to influence investment decisions and ensuring that the ERIC hub can guarantee user access to the national facilities.

- A long-term Investment Strategy should be developed. EMSO should develop a work-package for obtaining the commitments for the full funding of the ERIC. An inter-governmental funders working group (with sufficient mandate) should be considered.
- The ERIC statutes should be thoroughly worked over because of inconsistencies, such as the fact that member's rights are defined in more than one place; the organogram in the AEG Questionnaire does not seem to correspond to the attached draft statutes. The relationship between Director-General and the Board has to be precisely defined. It is recommended to empower the Director-General as much as possible. An Ethical Board should become a part of the governance structure.
- Parameters to monitor productivity have recently been proposed for the sites, agreements, data access and quality of papers and experimental applications, but KPIs with target values for the research infrastructure as a whole should also be identified.
- Relationships with EURO-ARGO, EPOS, SIOS, KM3NeT and ICOS should be developed as part of the activity plan. The relevant marine research infrastructures should set up a joint group to develop synergy and collaboration. Especially the relationship with KM3NeT requires attention, as KM3NeT mentions EMSO as their link to the marine research community.
- EMSO should extend its user community beyond the community of the Network of Excellence and should formalise its relationship with the international initiatives in the form of agreements.
- An international procurement coordination task force to contain costs might be envisioned, if the quoted procurement of EUR 300 million is handled site-by-site. This will also facilitate the development of new technologies, if a critical mass at European level would attract suitable investors.
- Once a business plan, a three-year construction plan and related budget breakdown, and KPIs for the project as a whole will have been developed, it is recommended that they are independently (externally) reviewed.
- A Risk Report should be prepared in due time.

Conclusions

EMSO has been on the ESFRI roadmap since 2006. In December 2012, seven countries signed an MoU as a declaration of intention. Despite a 2011 draft, no ERIC application has yet been submitted. So far there are no signed financial commitments, the current work breakdown structure is purely an institutional construction effort and there seems a reluctance to create a strong central hub. As such EMSO is not considered to be mature at this time.

The proponents constitute a network of strong national facilities and although they could have developed a convincing joint work plan, governance, and project organisation to become a truly integrated research infrastructure, they have not done so. The AEG was not convinced that they would change their approach and achieve maturity as a European research infrastructure by 2015.

EPOS — Infrastructure for the Study of Tectonics and Earth Surface Dynamics

Key issues and findings

El Mayor Cucupah Fault, Baja California, Mexico,
© Stefano Pucci - INGV

EPOS has been on the ESFRI roadmap since 2008. The scope of EPOS involves all 'physical processes controlling earthquakes, volcanic eruptions, unrest episodes and tsunamis as well as those driving tectonics and Earth surface dynamics'. In addition it will have, as a long-term plan to facilitate integrated use of data, models and facilities. The stated main objective is to integrate existing research infrastructures into a single permanent organisation. The overall value of the existing national research infrastructures presently engaged in the EPOS integration plan is estimated at EUR 350 million, which represents the investment in national research infrastructures and facilities over the last 20 years.

EPOS entered the EC funded Preparatory Phase in November 2010 with 20 partners from 18 countries (Italy, Germany, France, the Netherlands, Romania, Iceland, Switzerland, UK, Norway, Turkey, Ireland, Portugal, Spain, Greece, Sweden, Poland, Denmark and Czech Republic) and one international organisation, ORFEUS. Five other countries and another international organisation are associated partners (Austria, Finland, Israel, Slovakia, Slovenia and the European-Mediterranean Seismological Centre EMSC).

The construction and operation plans are still under definition. The research infrastructure will include the national research facilities, the EPOS Executive and Coordination Office (ECO), the EPOS Integrated Core Services (ICS) and the EPOS Thematic Core Services (TCS). The exact planning of the Thematic Core Services is not yet possible because the discussion on the respective geo-scientific communities represented by the different working groups is still ongoing. The budget for construction and running costs, excluding the national research infrastructures, is estimated at EUR 2.5 million per year and 3-5 FTEs in the headquarters (HQ). The ICS will be part of the ERIC, the TCS will be outside, but managed by EPOS through partnership contracts. Problems to be solved are said to include fragmentation of funding sources, management and legal structures and the uneven development of national research infrastructures for EU environmental research and solid earth science, but it is not clear what EPOS might do about that.

Detailed cost estimates are available for the core EPOS management functions and core services, but these are preliminary. In November 2013 EPOS will have a plan for the HQ. The funding model is available in outline form without details of cost sharing at this stage. Funding model and commitments are due in 2014.

Open competitive bids to locate the HQ and integrated core services will be solicited. A very large host country contribution is under discussion (80 % in kind and cash). The project team reports a great deal of enthusiasm from potential contributors. There are no current expressions of commitment at government level for the three components.

Discussions about possible options and decisions regarding governance are still in a very early stage. Letters of Intent were being collected at the time of the interview. An ERIC is the preferred structure, but the final decision is expected in September 2013. EPOS is planning on finishing the draft of its statutes in 2014.

There is a well-developed strategy and plan for engaging the scientific community and worldwide links, though the description of the user community is not very precise.

Discussions with industry at the January 2013 Bergen meeting reportedly demonstrated an interest from that side. EPOS states that it is aware of a large community of potential users of earth science data beyond the research community. However, during the EPOS Preparatory Phase it became apparent that involving this community requires resolving far more complex data management tasks (IPR and financial aspects) than they are currently addressing. They state that EPOS Preparatory Phase, however, is taking up discussions specifically with industry to investigate common grounds.

The main regime for access to data and material will be peer-reviewed open access. IPR questions have not yet been addressed.

The document on collaboration with other ESFRI research infrastructures mentions SIOS, not KM3NeT and EMSO. Collaboration has been set up with SIOS.

There is a list of risks, but these are all organisational and strategic risks. The project representatives believe that they are minimally exposed to technical risks, not even in ICT, since the volumes of transmitted data seem to be manageable. Risks from hackers, data modification and falsification (important when data would become the basis for insurance calculations) are not mentioned.

Recommendations

- It is essential that the proposers agree on the definition of the Thematic Core Services and start defining an activity plan, deliverables, an implementation schedule, a realistic budget and facility-wide KPIs. There is a need to ensure that the bidding process for HQ and Thematic Core Services does not lead to the exclusion of potential partner contributions (because of the proposed high host contribution). A clear Business Case and Investment Strategy should be developed. Structural funds should be also considered for this.
- Once the project documentation (business plan) is available, it is recommended that independent external scientific and technical reviews and an independent project cost review be undertaken. The reviews should also address the risk analysis. A positive result of such reviews is considered essential to show that a project implementation phase could be successful in cost, schedule and performance.
- The large number of groups and institutions involved will need to show that they can cooperate in a sufficiently coherent manner and that a path towards a well-managed distributed research infrastructure is established with a clear role for the HQ, not only with regard to the various ICS, but also to the TCS. To achieve the latter, EPOS should aim for sufficiently specific service level agreements with the national research infrastructures in order to be able to guarantee the quality and continuity of services.
- In order to engage the community and the financial stakeholders, it is very important to define a Delivery Strategy, indicating how the various partners could benefit from this research infrastructure. A gap analysis should be considered, also involving the Mediterranean countries not yet fully involved.

- Truly integrating the EUR 350 million worth of national investments and obtaining the estimated EUR 3-9 million financial commitments for the ICS and TCS is an ambitious goal, requiring high-level government commitment to be achieved. EPOS should consider setting up a high-level intergovernmental working group to organise the long-term funding commitments. The Board of government representatives could be given that task, provided it is composed of sufficiently high-level mandated government officials.
- Although EPOS is planning to complete statutes in 2014, they should start working on them as soon as possible, since time is needed to reach consensus decisions. In the statutes, clear lines of responsibility should be defined between the various bodies. This should include clear procedures for the nomination and election of an External Advisory Board. An Ethical Board should be considered and positioned in the future governance structures.
- Given the stated potential value of EPOS for industry, it is recommended to formally engage industry, for example by including representatives in the External Advisory Board. There is scope for promoting pilot cases for new EU leadership technologies in this domain using EPOS as a platform, if suitable industrial partners are found.
- EPOS should explore collaboration with KM3NET and EMSO to define areas of potential synergy and overlap, in addition to the collaboration with SIOS with which a joint project already exists.

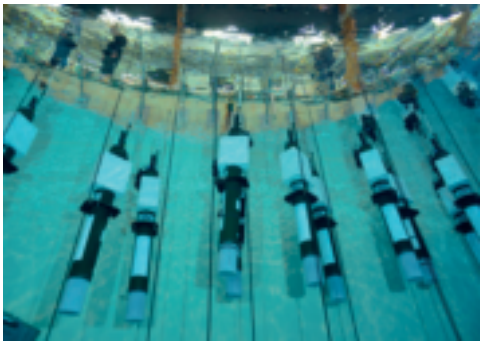
Conclusions

EPOS brings together an impressive group of facilities and partners dealing with various aspects of the Earth system. EPOS aims to have the funding model and commitments, or an Investment Strategy, as well as the statutes ready by 2014. The drafting of statutes for an ERIC has only recently started. This means that the conditions for maturity are currently not being fulfilled.

In order start implementation by 2015, an acceleration of the process and involvement of governmental stakeholders at a high level is necessary. The ambition to fully integrate EUR 350 million of national investments into EPOS could prove unachievable. The main financial uncertainty is the EUR 3-9 million per Thematic Core Service that should be committed. A more evolutionary model should perhaps be considered. However if the recommendations of the AEG are followed, which will involve substantial effort, then implementation by 2015 could be possible.

EURO-ARGO — Ocean observing buoy system

Key issues and findings



ProvBio float tank test. © Ifremer/O. Dugornay

EURO-ARGO aims to provide the European contribution to the international ARGO in-situ ocean monitoring programme. The international ARGO project maintains a large number of floats worldwide (with major contributions from the USA and Japan) to collect global data sets to understand and predict ocean and climate changes. It has been on the ESFRI roadmap since 2006. The overall aim of the research infrastructure is for Europe to jointly provide 25 % of the global effort in terms of floats deployed. This would imply deployment of 250 floats per year at an annual cost of just over EUR 8 million. At present commitments of EUR 4-5 million by initial members of the ERIC would allow deployment of between 150 and 200 floats per year. There does not seem to be a large negative scientific impact to this reduced level of activity. EURO-ARGO is addressing the uncertainty in funding of contributions to ARGO, which until now, is mostly from research funds without guarantee of sustainability.

Current members or observers in the ERIC are France, Germany, the UK, Netherlands, Italy, Bulgaria, Greece and Poland. Norway, Spain, Ireland, Turkey, Finland and Portugal could reportedly join the ERIC later on. The management team expects that the funding gap between the current commitments and the goal could be met via direct funding from the EU under the Global Monitoring for Environment and Security (GMES) programme. This is not (yet) secured. Central costs are estimated to be EUR 0.6 million per year, 50 % should be coming from EU funds.

The cost of each float is up to EUR 50 thousand. Floats have a lifetime five to six years. All data processing is done at the European level. Development of floats is ongoing to include biogeochemical data. Procurement of the floats can be done centrally or provided de-centrally as in-kind national contributions. Central procurement is expected to lead to economies of scale and to efficiency gains. Reportedly, there are contacts with the two European SME providers of floats. There are no decommissioning costs as the floats just stay in the sea.

Floats can also be provided by countries which are not members of EURO-ARGO. While there are high expectations of more countries joining EURO-ARGO, there is still an open question as to how to achieve further commitments. The Technical Appendix to the ERIC application describes current national commitments. It is not an integral part of the statutes and hence these commitments are indicative only.

EURO-ARGO plans to become an ERIC in 2013. This would facilitate transferring the existing cooperative arrangements into a legal body. This is necessary for EURO-ARGO to enter into contracts and manage central procurement.

For a truly European role, it is essential that EURO-ARGO represents all European countries contributing to ARGO. Awareness of the added-value tasks of the central facility of EURO-ARGO will be decisive for obtaining support.

As part of ARGO worldwide, there is widespread international use of ARGO data, including from Europe-provided floats. There are about 100 European users taking part in the deployment of floats and in the analysis of data. About one-third of the 200 scientific publications using ARGO are from European authors. Data from EURO-ARGO is fully open access. The information is also for the general public, and it would be good to have a KPI that monitors this aspect.

The risks mentioned in the questionnaire refer only to possible financial shortages in the setting-up phase. The risk insurance of Article 12 of the draft statutes could not to be identified in the preliminary budget calculations. The risk of not meeting the delivery rate of floats is not addressed.

Recommendations

- The management should clarify the likelihood of securing additional funding from European bodies (EC GMES) by developing an Investment Strategy, to supplement the contributions from the ERIC members, to enable the deployment of the target number of floats.
- Current commitments of partners are indicative. Focus should be on obtaining firm commitments from partners. A clear engagement policy with stakeholders and an investment strategy should be developed.
- In order to achieve a more complete representation and voice of Europe in ARGO, it is important to expand European country participation in EURO-ARGO. Creating a time-limited temporary position (e.g. observer) for countries contributing to ARGO, not yet able to join, could be considered as an intermediate step. To achieve this, EURO-ARGO should raise awareness among European and international users of the importance of EURO-ARGO. Efforts should include Mediterranean countries.
- Future developments in governance and legal issues should take the importance of the European dimension into consideration. In particular, contracts with national partners for the national inputs of floats and services should be concluded and e.g. the role of EURO-ARGO in procurement should be accepted, as this could increase cost efficiency, but also help Europe to test and build leading technologies in this domain. With regard to the international level, EURO-ARGO should be enabled to operate and speak on behalf of the European members.
- It is recommended that ethical issues be explicitly addressed in the ERIC. It is not adequate to rely on national-level legislation or international governance and regulations, especially because this is a European research infrastructure operating in a global setting.
- Responsibilities for nominations and appointments to the Science and Technical Advisory Group should be decided. Experts should be appointed on the basis of transparent procedures. It is not enough to say that they should be as independent as possible.
- In addition to the KPI of 'funding sustainability', which is the main declared goal of EURO-ARGO, other KPIs should deal with the novel and enhanced role of the EU in the ARGO project and the enhanced Europe-wide visibility of the research in question. Target values should be defined for the KPIs in order to allow future evaluation of the performance.

- EURO-ARGO and the marine component of ICOS could benefit from each other, as they both address monitoring (ICOS localised, ARGO floats). Discussion should take place with ICOS on how to maximise synergy between the two projects.
- EURO-ARGO should develop a Risk Report, not only addressing the shortages in funding and the risk of not meeting the delivery rates of the floats, but also the environmental risks of the fate of floats after their operational lifetime.

Conclusions

EURO-ARGO has been on the ESFRI roadmap since 2006. It aims to be the European voice in and contribution to the worldwide ARGO in-situ ocean monitoring network, which so far has made crucial contributions to the understanding of ocean processes and their relation to climate. In October 2012 revised statutes were submitted, as part of the ERIC application. EURO-ARGO expects to formalise the commitments in 2013. Currently they report that over 50 % of the necessary commitments are in place.

Whilst currently EURO-ARGO can thus not be considered mature, it appears to be approaching maturity, which should be achieved by 2015, if the AEG's recommendations are followed.

IAGOS — Climate change observation from commercial aircraft

Key issues and findings

IAGOS is a distributed infrastructure in the field of Environmental Sciences, which has been on the ESFRI Roadmap since 2006. The preparation phase started in 2008 and builds on already existing co-operations (MOZAIC and CARIBIC) that can be considered as successful proofs-of-principle for the functioning of the intended infrastructure. Technical problems and licensing problems (equipment to be installed on commercial aircraft) seem to have essentially been successfully solved.

IAGOS Air Sampling Probes on the Lufthansa A340 Viersen. Source: Lufthansa

IAGOS only needs a relatively small amount of money for investment (EUR 15 million) for equipping 20 commercial aircraft with scientific instruments. Costs of equipment, deployment and operations are well defined with an R & D activity in place for more advanced equipment.

Commitments in writing exist from Germany and France. Funding from the National Environment Research Council NERC in the UK is only via responsive mode grants (i.e. with no long-term commitment). Other countries (including those from outside the EU) are quoted to be 'strongly interested', but are not yet ready to contribute. This was explained with historic reasons (continuity from the predecessor project MOZAIC). In addition, the fact that vertical atmospheric profiles are collected only at ascent and descent, restricts the primarily interested countries to those where the scientific-instrument equipped aircraft (mainly intercontinental) are taking off and landing. Currently committed funding is only sufficient to fund 30 % of the research infrastructure. The major part of the cost for the investment and the operations is and will remain with the contributing institutes. Additional (national roadmaps) funding is directed to the national institutes. The required human resources are limited, since mostly logistical and administrative activities are needed and these are presently being done by the proposing host organisation.

The binding commitments of the present shareholders are for the Preparatory Phase but, though credible, are not binding for the operations phase. Airlines, according to the proponents, are ready to provide free transportation of the instruments. However, no written commitments were shown. No conflict of interest is seen by the AEG when airliners collect atmospheric data, as the airline has no influence whatsoever on the data taking and data handling.

The foreseen legal model is an AISBL. An ERIC is considered 'too heavy' in view of the size and complexity of IAGOS, but is still under discussion for 2015. The proposed governance structure is considered appropriate for the infrastructure by the AEG. The Science Advisory Board is foreseen to be strongly international, including people from other research organisations.

Regarding KPIs, these are mainly related to the quantity of data obtained. It is important to remark that according to the proponents the data obtained by aircraft are preferred by the users to those obtained by satellite observations, so a comparative KPI could be developed here.

Around 1 000 industrial users (e.g. Boeing) are interested. A good KPI is the number of publications and citations having grown significantly in comparison to predecessor projects. Data are being used for the validation of atmospheric models, but are mostly used for modelling, together with data obtained on other kinds of infrastructures. Open access and IPRs are not an issue. Access is defined by the Advisory Board. There are contacts with COPAL and it would be important to develop common standards for atmospheric data from the two research infrastructures.

There is no risk report, though those risks related to equipment of aircraft are mainly strongly mitigated by certification of everything that is installed an aircraft. In view of the well-advanced preparation of the organisation, the licensing process being near to completion, the already prepared instruments for the equipment of the aircraft and some aircraft already equipped, there seem to be little risk of delay. However, a risk report would be advisable.

Recommendations

- Most of the material provided comes from an application to the German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF), and approval of the German funding proposal by BMBF is vital for the continuation of the project. It is recommended by the AEG that binding commitments from other shareholders are sought and a detailed financial plan should be ready as soon as possible.
- Only three countries (Germany, France and the UK) at the moment seem to be ready to contribute to the infrastructure (the UK only at the level of a University), meaning that the currently committed funding is only sufficient to fund 30 % of the research infrastructure. It would be important to understand the barriers and bottlenecks in engaging additional countries and attracting additional funding to close the current gap.
- The AEG also discussed the alternative of launching IAGOS as a cooperation of several partners instead of setting-up an infrastructure. In view of the much better visibility of an infrastructure on a worldwide scale the infrastructure was preferred.
- The AEG recommends also including industrial users in the Supervisory Board, as well as members of the civil society, given the sensitivity of the data findings.
- Since data of societal importance (i.e. pollution) are likely to be collected, an Ethical/Bioethical Board and an appropriate corporate social responsibility policy should be set up in due time.
- If the infrastructure decides to go on for an ERIC, future statutes should be looked into very carefully because of specific relationships between existing and future partners of this research infrastructure.
- The past record of the MOSAIC collaboration is a sufficient guarantee that the core institutions have sufficient project management expertise, but because many additions are planned, care should be taken to monitor the project-relevant operational record (management, procurement) of the additional organisations.
- There are virtually no central facilities and the collection of individual procurement, staffing and management-related efforts could benefit from some organisation-wide agreed criteria and procedures. Care should be taken to minimise the cost increase

that may come from splitting the planned EUR 20 million procurement in several individual national or institutional contracts.

- Some degree of centralised strategic oversight and planning of the national investments should be considered by the central governance structure. Contacts and collaborations with other research infrastructures generating atmospheric data are encouraged as well as development of common data standards.
- The current involvement of the wider (European) research community is through workshops and conferences. It is recommended to engage the scientific community in a more structured manner. This could help in broadening the (financial) support basis.
- The internal KPIs of the different participating institutions should be the basis for developing facility-wide KPIs for the different aspects, including technical and scientific aspects, user-related parameters, as well as societal impact. Once quantitative targets (KPI values) are identified to monitor and assess project success, it will be important to perform credible external reviews of the different research infrastructure aspects. This might be complicated in view of the network character of the project, but internal boards are not enough.

Conclusions

IAGOS is in a well-advanced status and is mature in many respects. The main issue to be resolved is the need to secure further funding commitments, as those currently in place would only enable 30 % of the planned infrastructure.

However if the AEG's recommendations are followed then the research infrastructure can be implemented by 2015 at some level.

ICOS — Integrated Carbon Observation System

Key issues and findings

ICOS (Integrated Carbon Observation System) is a distributed research infrastructure that aims to perform high-precision monitoring of green-house gas concentrations in the atmosphere and oceans. ICOS has been on the ESFRI Roadmap since 2006. The Preparatory Phase which started in 2008 is coming to the end in 2013. The current member countries include Belgium, Czech Republic, Finland, France, Ireland, Italy, Netherlands, Norway, Poland, Spain, Sweden, Switzerland and the United Kingdom.

Greenhouse gas instrumentation.
© Juho Aalto, University of Helsinki, Finland

The central entity of ICOS is comprised of the Head Office (HO) and the Carbon Portal (CP). The majority (80 %) of costs for the operation of the Head Office are covered by Finland and France. The Central Facilities (CF) of ICOS have their own cost structure and are financed mainly by the host country (80 %), the remaining comes from cash contributions. The different CFs (Atmospheric Thematic Centre (ATC), Ecosystem Thematic Centre (ETC) and Central Analytical Laboratory (CAL)) are being built on national funding: ETC in Italy, Belgium and France; ATC in France and Finland; CAL in Germany, and the Head Office in Finland. The call for hosting the Ocean Thematic Centre (OTC) is presently open. Likewise the location of the Carbon Portal has not yet been decided. Therefore some big sums are currently still missing in the budget. This is a critical area that needs to be resolved.

The legal structure of ICOS is well designed, and contracts are envisaged for the quality assurance of services provided by national central facilities contributing to the research infrastructure. However, the aim is to replace the present governance structure with an ERIC. Statutes have been drafted and, after input from the member countries, were recently approved. All aspects of governance were addressed in a serious way and the decision to postpone the submission of the ERIC application to 2014 seems realistic time-wise. There is an awareness of societal issues and steps have been taken to minimise ethical risks. During the interview, the managers said they would think about an Ethical Board.

A credible and timely staffing plan exists. Negotiating contractual agreements with every central facility and each participating station seems a very sensible way of guaranteeing standardisation and the European dimension. Once KPIs are identified to monitor and access success, it will be important to perform external reviews on the technical, financial and recruitment aspects of the research infrastructure, internal reviews are not sufficient. ICOS depends heavily on the support from Finland and France, and this could represent a significant risk. It is important that the stakeholders' commitments are documented and organised, and commitments from other governments are obtained. The lack of engagement of important research institutes in the field was noted.

An ICOS user is defined as any entity which is interested in using any of the products of ICOS. The user community is very large and wide, covering organisations, initiatives and business; however the major part is from academia. There will be free and open access to the data generated by ICOS. How the access, data and IPR will be handled in the future are presently under preparation. ICOS is also providing access to standards, protocols and calibrations, and it is important that this is carried out in synergy with other related infrastructures like IAGOS, COPAL and EURO-ARGO.

There is a good risk assessment for the realisation of the infrastructure, but no risk assessment linked with the technical realisation, and the schedule risk analysis is deferred to a paper in preparation. Likewise there are no risk considerations in relation to the long-term data archiving.

Recommendations

- The research infrastructure is included on a number of national roadmaps, but needs to address potential funding bottlenecks/problems. Until now the central funding depends heavily on Finland and France and this could represent a significant risk.
- Engaging the financial stakeholders should be organised as a dedicated work-package led by an experienced science policy-maker. There are important research institutes and energy suppliers in the field that are not involved in ICOS. Expressions of interest in the Carbon Portal should be turned into a firm commitment as soon as possible. There is potential to increase the impact and visibility of ICOS by increasing the number of stakeholders.
- Mechanisms to define a sound communication strategy with regulatory bodies should be considered, as some ICOS data could have sensitive aspects.
- The role of the ERIC in the recruitment of key staff should be specified in the contracts concluded with the members. Negotiating contractual agreements with every central facility and each participating station should be an opportunity to influence each institution to similar procedures for recruitment, procuring, HR policy, etc.
- The role and membership of Scientific Advisory Board should be clarified at both present stage and especially in future developments. An independent Ethical Board should be included in the governance structure.
- Care should be taken to minimise the cost increase that may arise from splitting the planned EUR 120 million procurement for national stations into several national contracts.
- Internal KPIs of the different participating institutions or from other infrastructures such as the US National Ecological Observatory Network (NEON) should be the basis for developing research infrastructure-wide KPIs for the different aspects, including technical and scientific aspects, user-related parameters, as well as societal impact. Once KPIs are identified to monitor and assess success, it will be important to perform credible external reviews, reviews by internal boards will not be sufficient.
- There is potential for industrial engagement, and this should be developed in a structured way.
- Maintain and enhance the standardisation role of data. Develop a transparent data-access policy, which covers IPR.
- The links to other research infrastructures in the same domain of science (such as IAGOS and EURO-ARGO) should be further developed, as well as the links to international users such as ECMWF and global research programmes such as IGBP that rely on ICOS data. Standardisation with the NEON project seems an opportunity that should not be missed.

- An assessment of the risks associated with the technical realisation of the project and long-term data archiving should be performed.
- The planned schedule risk analysis should be completed soon.

Conclusions

ICOS has been on the ESFRI Roadmap since 2006 and will reach the end of the Preparatory Phase in 2013. Good progress has been made in many areas but central funding depends heavily on Finland and France and this could represent a significant risk. Expressions of interest in the Carbon Portal need to be turned into a firm commitment as soon as possible.

However, with focussed efforts and if the recommendations of the AEG are followed, then implementation by 2015 would be possible.

LIFEWATCH — Infrastructure for research on the protection, management and sustainable use of biodiversity

Key issues and findings

The planet is the laboratory. © Hector Garrido

LIFEWATCH is a distributed infrastructure that has been on the ESFRI Roadmap since 2006. It is a networking effort and e-Science infrastructure for the support of biodiversity and ecosystem research.

The total planned cost of the LIFEWATCH infrastructure over five years is EUR 220 million for construction and operations. The members foreseen for the proposed ERIC will provide a GDP-related contribution of which 85 % will be in-kind and 15 % in cash. Spain, Italy and Netherlands are ready to pay a host premium; both Italy and Spain could use the European Regional Development Funds (ERDF). According to the LIFEWATCH representatives, EUR 80 million have been committed so far and non-binding MoUs have been signed by representatives of eight EU Members. LIFEWATCH is confident that other Members will step in on some timescale, but none of the three biggest EU countries, from which according to the financing table the largest contribution is being expected, have signed the MoU. Host premium contributions were also mentioned from regional governments like Andalucía, but not quantified.

All of the construction and operating costs should be coming from confirmed national contributions to the ERIC, but it could not be verified whether there are commitments for the envisaged amount. The funding model assumes that common facilities will be supported from the 15 % cash contributions, at present however that cash fund is just 15 % of EUR 80 million. The distributed independent centres will be supported by the 85 % in-kind contributions through 'construction agreements'. However, LIFEWATCH considers that it can operate at a much-reduced level of commitment (at correspondingly lower level of activities and services). They feel that the essential central elements are secure.

The draft ERIC statutes are not always clear and important issues, including procedures and majorities for financial decisions, are in a secondary document that has to be agreed by the LIFEWATCH General Assembly itself at the time of the interview. It has to be noted that the draft Statutes will allow admission of intergovernmental organisations as full members with a simple majority, with a free definition of their contributions, but with full right to vote. It is not clear that this would be accepted by all potential contributors. The management recognises the need to develop methods to cope with these difficulties and to ensure that at the end of the Preparatory Phase they can secure (limited) advance funding. No evidence was presented to support the optimism that this will be successful.

LIFEWATCH seems to be a well-designed infrastructure with a nested structure behind the master plan.

The expenditure breakdown and the foreseen staff (> 500 person years in five years) are very substantial but there is mainly only a table and few explanations to support the figures. LIFEWATCH claims, however, that all budget projections were developed in a standardised way, allowing for combining and comparing different cost calculations. LIFEWATCH says that 'the costs are to a large extent associated with new software development, mainly outsourced to the private sector for generally available solutions'. It is not clearly visible however what the investment amount will be for the central facilities, how their operation costs are calculated or how many staff are available for the central facilities already.

Relations with national facilities through construction contracts and, later on, service level agreements are a good idea.

It is not clear how the diversity of user communities will be engaged.

There is a 75-page Risk Report. Many of the risks are standard within normal management, but there are also risks to be taken seriously in distributed e-infrastructure organisations. Too often 'loans from the EIB' are mentioned as a risk-mitigation strategy.

Recommendations

- LIFEWATCH should seek assistance from the European Commission to identify best practices and lessons learned by other research infrastructures in dealing with the difficulties of getting financial commitments in place. This is important, in particular, for ERDF because of the stringent time constraints for their use.
- Spain, Italy and Greece propose to use ERDF. The legal issues surrounding the approval of these funds and their usage for a common project likely to be over EUR 50 million need to be clarified. The AEG recommends that the LIFEWATCH management urgently examines the legal situation with regard to the use of structural funds, as the project should be analysed as a whole and validated by DG REGIO, rather than only by national authorities, as the individual national investments would require.
- The proponents need to identify the bottlenecks and timescales for missing financial contributions.
- It seems that there is a matrix of in-kind contributions that corresponds to a WBS. The aim is that the in-kind contributions from the Member States fill these individual elements. Where there are work-packages that nobody offers to provide, the cash fund will be used to procure the work. Loans from the EIB may be considered, but it is not evident who will be the borrower(s).
- Governance should be more clearly defined at all levels. Inconsistencies in documents should be eliminated and governance covering financial commitments and budget structures should be clearly defined and strengthened. The finalised statutes should be reviewed by a competent lawyer.
- Quick implementation of the ERIC is desirable for shortening procurement time. The structure of the central facility should be clarified as soon as possible and the responsibilities and staff charged with implementing procurement strategy urgently defined. Fast ICT acquisition of tools that can become obsolete will be a big challenge, in particular because of the stringent time constraints for the use of ERDF and the incomplete definition of the ERIC fast-track procedures. A reasonable plan in this direction, describing specific initiatives, should be developed.
- It is recommended that LIFEWATCH introduces an Ethical Body that is completely separate from the Scientific Advisory Body.

- Development of a detailed staged activity plan for the first years, taking into account available staff and a realistic assessment of the evolution of the secured contributions, is strongly recommended, including in-kind contributions from founding organisations. Engaging the wide diversity of users requires special attention through a dedicated action plan.
- An external (independent) review of the Construction Plan developed during the Preparatory Phase, of the schedule for its gradual implementation and of the initial activity plan seems essential and should be performed urgently in parallel with the ERIC effort.
- It is recommended that standards for data and access should be developed.
- The AEG doubts that such an important infrastructure (EUR 220 million in five years with no secured contributions until now) could be built-up quickly with a small, starting phase team. The research infrastructure should be scaled down and constructed in phases. A first construction phase with the confirmed contributions and achievable — technical, staffing and organisational — milestones is therefore strongly recommended. This would make more credible the chances of a later increase to the size of the infrastructure foreseen in the presented papers.

Conclusions

The infrastructure is still not mature for implementation at this point in time. There are many important issues to be solved that could become very time consuming. The main issue is that the countries with the highest contributions are not yet on board and a 'Plan B' for an infrastructure of reduced size is not available.

However, provided that LIFEWATCH decides to follow the AEG's recommendation to scale down and addresses the other recommendations, implementation could be achieved by 2015 if the necessary staff and resources are available. If big contributors could be convinced to join, further growth to the originally planned size would be possible in the years thereafter.

SIOS — Upgrade of the Svalbard Integrated Arctic Earth Observing System

Key issues and findings

Polish Polar Station: © Marek Szymocha

The goal of the Svalbard Integrated Earth Observing System (SIOS) is to establish an observational research infrastructure for integrating studies of geophysical, chemical and biological processes in the Arctic region. SIOS will be a new structure integrating the activities of a number of research stations and facilities on Svalbard. It will include the creation of the central structure (the Knowledge Centre) plus upgrades and construction of existing and new facilities. SIOS has been on the ESFRI Roadmap since 2008 and the EC funded Preparatory Phase started in 2010. The project management has applied to prolong the Preparatory Phase since they state that the three years of Preparatory Phase were largely spent planning the upgrades of the individual facilities as opposed to planning an institution.

Research is based in Svalbard centres around Longyearbyen and Ny-Ålesund, the most accessible areas in the high Arctic. Ny-Ålesund is a permanent settlement based entirely around research. The Norwegian Meteorological Institute has outposts at Bjørnøya and Hopen. Norway grants permission for nations to conduct research on Svalbard, resulting for example in the Polish Polar Station and the Chinese Arctic Yellow River Station, plus Russian facilities in Barentsburg. EISCAT also has a significant part of its infrastructure on Svalbard. Weak relations exist between SIOS and EISCAT-3D.

The SIOS Knowledge Centre is seen as the real core of the infrastructure, but work has only recently started on its definition. Until now the focus has been on the upgrade of the observation system, though it is planned to have an implementation plan for the Knowledge Centre by 1st October 2013.

The SIOS Preparatory Phase is coordinated by the Research Council of Norway, with 14 participating countries (Norway, Sweden, Denmark, Finland, UK, Germany, France, Netherlands, Italy, Poland, Russia, China, Korea and Japan) plus five associated countries (Spain, Czech Republic, USA, India and Canada). Investment costs of EUR 50 million in 2013-2018 are estimated for the upgrade of the infrastructure, including the proposed Knowledge Centre. In-kind contributions are not specified yet, but are foreseen to be 'substantial'. The existing and upgraded research infrastructures will still be nationally owned.

While the Norwegian government is clearly committed to funding SIOS at very substantial level, ultimately success will depend on what others are willing to contribute. Germany will perform a major upgrade, as will Russia. Italy and the UK are optimistic about the chances for an upgrade, but this has not yet been confirmed at government level.

It is envisaged that there will be a host contribution plus contributions from partners to cover operating costs, but no details have yet been proposed or agreed. Partner countries will 'buy-in' to the infrastructure based on an agreed development plan 'in a synchronised way' but exactly how this will happen is yet to be agreed. The planning of the Preparatory Phase activity did not take into account the significant and iterative work needed between the consortium and the stakeholders.

Governance structures are still in very basic outline form and statutes are not yet available and only about one year remains in the current Preparatory Phase. It is not clear in which direction the decision on the legal entity will go at this point. SIOS is one of the few research infrastructures that are aware of gender issues and plans to address them.

The project representatives have little quantitative information on the prospective user community and a user policy is presently unavailable.

Recommendations

- It is important that the appropriate level of representation exists in the governance structure of the potential funding partners. These partners need to be intimately involved in developing the research infrastructure rather than be approached later with an offering.
- Partner countries are expected to 'buy-in' to the infrastructure based on an agreed development plan 'in a synchronised way', but this seems rather weak to qualify as an integrated research infrastructure as opposed to a loose network of geographically related research stations. The role of the SIOS Knowledge Centre needs to be formalised and strengthened to add cohesion to the partnership. Methods to coordinate investments from the partners should be developed to maximise impact and minimise costs.
- The development of government commitments to SIOS should be cast into a dedicated work package led by people familiar with Engagement Policy at international level.
- The likely host contribution needs to be established as soon as possible to enable planning and discussion with potential partners.
- Weak relations exist with EISCAT-3D. Relations with EMBRC, EMSO, EURO-ARGO should also be developed and formalised.
- To define the new governance structure and decide upon the different legal options should be the main priority, especially because the legal structure of the knowledge centre has not been discussed as yet and was only recently introduced as a possibility.
- The final selection of the legal structure appears urgent, so that a recruiting plan can be developed and an internationally recruited and highly recognised research manager with first-hand experience of managing large-scale research infrastructures can be quickly hired and put in charge.
- Methods should be rapidly developed to converge on the major issues to be decided upon, and the results submitted to an independent external, scientific, technical and financial review.
- Convincing, measurable, science-based KPIs should be developed to motivate project membership and to be used for fundraising with the different governments.
- During the Preparatory Phase the management team should work on obtaining an overview of the combined SIOS user community, in terms of size and research interests and possible overlap with other ESFRI research infrastructures and develop a clear user strategy including data access.

- Given the sensitive nature of the environment, ethical issues need to be addressed carefully. Recommendation is to set up a separate Ethical Board.

Conclusions

Although SIOS has been on the ESFRI Roadmap since 2008, the focus to date has been on upgrades to individual observation stations rather than on developing the concept of a truly integrated infrastructure. Development of the SIOS Knowledge Centre concept including its governance and funding is vital if SIOS is to be anything other than a network of individual infrastructures.

Once developed, the SIOS Knowledge Centre would need a new independent evaluation. SIOS has clearly not yet reached maturity and the chances of achieving readiness for implementation by 2015 are considered minimal at this stage.

3.3 Energy

ECCSEL — European Carbon Dioxide and Storage Laboratory Infrastructure

Key issues and findings

ECCSEL has been on the ESFRI Roadmap since 2008. It addresses CO_2 capture and storage (CCS) techniques. The Preparatory Phase has been split in two parts: the first (Preparatory Phase 1, 2011-13) concentrated on legal, governance and financial aspects, while the second (Preparatory Phase 2, 2013-15) deals with the business plan, operations centre and all of the rest. Norway is the host, and nine other countries are involved. At present there are no government commitments, other than from Norway. A Policy Contact Group has been established and has met twice. The preferred legal form is declared to be an ERIC, but a Belgian AISBL or a Norwegian AS are also said to be acceptable as a Plan B. In the documentation there is a draft governance structure with two management levels above the Director, which makes decisions for the Director more difficult.

Two layers of the ECCSEL organisation are expected to exist: one layer consisting of a network of distributed laboratories that are, and will continue to be, owned by individual ECCSEL members, and another layer consisting of ECCSEL pilot and large demo sites, requiring technical, organisational and financial cooperation between ECCSEL members and other industrial organisations. In the answers to the Questionnaire, investment costs for 2015-2030 (from national and multinational sources, European structural funds, EIB) are foreseen to be EUR 164 million with EUR 11 million per year in operating costs. Therefore, including investment and operating costs, the annual contribution required reaches EUR 22 million. In the Questionnaire, the management states that only funding for the Preparatory Phase (until 2015) has been committed at this stage.

In their cost scenarios document, the management maintains that a total budget of approximately EUR 345 million for the joint research infrastructure will be required, based on an organic growth development and the envisaged research needs for CCS in Europe. Regarding future funding mechanisms, the management states that the actual useable future (2015 onwards) funding instruments are unclear and that the funding mechanism can only be projected as an envisaged outline, although they expect that the cost to execute the research will be covered by the proposed funding scheme of Horizon 2020.

Only very top-level costs per lab with no breakdown have been provided. Limited discussions of national partner contributions have taken place so far.

The biggest activity of Preparatory Phase 1, a gap analysis, identified the need for capture research infrastructures and storage research infrastructures. Knowledge and innovation for industry are declared targets. The main concern is the storage part. The partners will need to agree on one to three locations. This is more easily done in countries such as Australia than in Europe. The management presented an overall plan for the start and growth, based on existing facilities. Estimates of the cost contribution from the Member States are available. The management are aware that this evolutionary model requires strong commitment to the governance. It is not clear that this will be realised. A Memorandum of Understanding, should be in place for at least some countries. They are working to realise the recommendations resulting from PP1.

The activities are still at a very preliminary stage of definition. The process of taking the MoU to other partners/countries has just started. Only a Preparatory Phase 2 description of work is currently available, mostly targeting non-scientists and containing few specifics about the substance of the business plan, approach, science and technology. Activities are expected to include a First Stage for integrating and upgrading existing research infrastructures and a Second Stage for building new lab 'pilots and test sites'. No recruiting plan, work breakdown structure or facility-wide KPIs have yet been developed.

There are no explicit signs of engagement of the scientific community beyond the institutes involved. At present there does not appear to be a clear view of the nature of the user community, and how access will be given and data will be handled.

No comprehensive risk analysis has yet been developed, although during the presentations the management stated that the risk related to the chosen legal form is considered low, the risks related to financial viability is considered medium to high, and that the risks related to scientific and technical attractiveness is considered low to medium.

Recommendations

- In order to make ECCSEL more than a network with an access programme, commitment to an organic growth model should be negotiated. This will require commitments that can only be made by governments and a willingness to give powers to the central entity. This requires a major dedicated work package, adequately staffed with political skills. An engagement strategy with EU countries should be pursued, as it is desirable that more countries participate to this research infrastructure to achieve a European dimension.
- There is an urgent need to establish the funding mechanisms for implementing the research infrastructure. This can only be achieved via engagement with key stakeholders and prospective funders, including industry. Consideration should be given as to whether this is a network of national facilities or whether it is a truly European distributed research infrastructure. In order to establish this it will be crucial to understand whether there will be European investment in the individual labs or whether this will be via national funding and then to establish what the role and scope of the core coordinating structure will be, including the (contractual) relationships between the core structure and the national facilities. It is recommended to build a central hub at a location in Norway more accessible by EU partners, to facilitate their participation.

- As the ERIC is the preferred legal model, it is important that government representatives are gathered around the table. In this type of research infrastructure it will be important to engage the ministries of Industry and Energy. This is a separate work package, requiring specific competences, not (yet) sufficiently addressed.
- It is important to finalise a governance structure and empower a Director, by making him as independent as possible, preferably reducing the number of management levels. Discussions about governance and legal issues should start as soon as possible in order to reach agreement. An Ethical Committee in the structure of the governance should be considered.
- The WBS should be stepped up in contents and reach and facility-wide KPIs developed to persuade prospective shareholders and engage the scientific community beyond the institutes already involved. The general goal of performing 'cutting-edge' and 'world class' research and establish a 'new big lab' in CCS is certainly worthwhile, but developing a true technical activity plan in the different areas envisioned (pre-combustion, oxy-combustion and post-combustion CO_2 capture, or equivalent for industrial processes) should be the first priority. Engaging industry should be given higher priority. A delivery and investment strategy must be developed.
- ECCSEL and EU-SOLARIS could both benefit from exchanging experiences.
- A risk analysis should be developed.
- The Preparatory Phase should be used to obtain an overview of the user community. Both access to the facility and access to the data should be considered. A KPI-related to the user programme should be developed.
- Once an activity plan based on the available staff, deliverables, implementation schedule, a realistic budget, governance, funding strategy and project-wide key-performance indicators have been developed, it is recommended that an independent scientific and technical review and an independent project cost review be undertaken. The reviews should also address the risk analysis. A positive result of such reviews seems essential to show that a project implementation phase could be successful in cost, schedule and performance.

Conclusions

Although ECCSEL has been on the ESFRI Roadmap for five years, the second Preparatory Phase started only recently (2013-15) and the research infrastructure is still at a very early stage of definition. A technical plan, WBS, governance, business model, KPIs and funding strategy all need to be decided.

Once sufficiently developed, the project will need a new independent evaluation. ECCSEL is in the very early stages and has clearly not yet reached maturity. In view of this, the chances of achieving readiness for implementation by 2015 are considered minimal.

EU-SOLARIS — European Solar Research Infrastructure for concentrating solar power

Key issues and findings

EU-Solaris aims to create a pioneering, distributed research infrastructure for Solar Thermal Electricity (STE) and has been on the ESFRI Roadmap since 2010. The project has only recently entered the EU-funded Preparatory Phase (November 2012), which is funded through to 2016. The host institution is the Centro Tecnológico Avanzado de Energías Renovables (CTAER) of Spain and partner countries include Cyprus, Germany, France, Israel, Turkey, Italy, Greece and Portugal.

CNRS PROMES 1MW Solar Furnace,
© Centre National de la Recherche Scientifique (CNRS)

The project management maintain that it is too early to give a cost estimate or cost breakdown of the future infrastructure. The future investments of the partners' research infrastructures, through to 2020, are estimated at EUR 120 million and relate to upgrading existing infrastructures as well as creating new infrastructures. But such a sum is just an estimate of the national investments expected in this area, and it is not yet clear how much of this will be within the scope of EU-Solaris. The management are fully aware that financial sustainability is fundamental to the execution of the project and aims to engage both private and public funding sources from the very beginning.

The project cost, contribution model, activity plan, organisation/governance, KPIs, etc., are all to be determined during the Preparatory Phase. At this stage there is no information on the proposed governance, other than that the plan is to create a new legal entity. A major challenge will be to merge into an open-access research infrastructure, since some of the individual national institutes have never been open-access infrastructures or user facilities.

One of the main declared targets is to help the European STE industry to develop. Furthermore, EU-SOLARIS aims at becoming a qualified consulting agent for the European Commission in advising on the support policies and specific programmes on STE R & D, such as the SET-Plan and Horizon 2020.

In the present state there is not a clear picture of the size and composition of the user community.

Recommendations

- Creating government commitment for a construction phase in the range of EUR 120 million (which is only an estimate of the national partners' investments expected in this area) will be a major challenge. Planning of the Preparatory Phase should ensure that this issue is afforded high priority. The work package for an Engagement Strategy of the Preparatory Phase should be political in addition to technical.

- For EU-Solaris to become a truly European research infrastructure it will be essential that the institutes transform their facilities to be open to external use. Additionally, the central facility should be constructed so that it exercises effective authority over the nodes (single point access and review, quality assurance, access rules etc.), including the steering of investments in order to enhance cost effectiveness.
- The project management should start seriously thinking about legal issues as early as possible as it takes a long time to negotiate a final solution. Experience from other research infrastructures indicates that matters of this kind imply lengthy discussions. An issue for special consideration will be the degree to which individual centres retain their independence. Again this could involve lengthy discussions.
- Engagement with industry and with a wider research community is crucial to successful implementation and these activities should be fully addressed in the Preparatory Phase. Relevant funding at national and international level to address potential leadership technologies should be considered.
- Because one of the main declared targets is to help the European STE industry to develop, to make any industry-orientated, proprietary research compatible with open-access, peer-reviewed activities will be a major challenge. It is strongly recommended that a number of international industrial concerns be involved at an early stage in the design of the EU-SOLARIS business plan, governance model, KPIs, etc.
- EU-SOLARIS might benefit from exchanging experiences with ECCSEL, which has similar characteristics.
- The Preparatory Phase should be used to gain knowledge on the expected user community and develop user access to the facility and procedures for handling of IP questions. In addition the work package concerned should be used to develop engagement of the user community.
- It is strongly recommended that once an activity plan, business plan, governance model, user-access model, KPIs, etc. are developed, they are independently (externally) evaluated. The reviews should also address the risk analysis. A positive result of such reviews will be essential to bolster confidence that a project implementation phase would be successful in cost, schedule and performance.

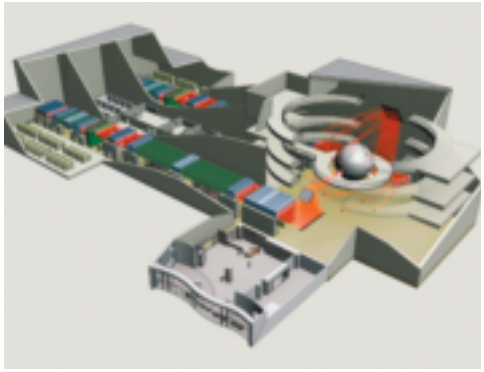
Conclusions

EU-Solaris is in the very early stages of the Preparatory Phase and many of the recommendations should be seen as pointers to the issues that need to be addressed. The main concern regards the challenge of bringing national research infrastructures academia and industry together into an open-access research infrastructure. Appropriate private public partnership models should be pursued at early stage.

Given the early stage of development, the AEG considers that the chances of achieving implementation by 2015 are minimal.

HiPER — High power long pulse laser for fast ignition fusion

Key issues and findings



HiPER has been on the ESFRI Roadmap since 2006. Substantial changes in vision and project direction as compared to the original plan were presented in the documentation and during the interview.

The main target of the project has shifted to energy and grand challenges, with more attention to *en route* economic benefits and an emphasis on ancillary technology development within a phased implementation, following a roadmap with a managed risk approach. Therefore the entire focus of the project appears to have been changed from a US National Ignition Facility (NIF) type of approach to a US Laser Inertial Fusion Energy (LIFE) type of approach, i.e. repeated ignition for energy production, focusing on the gradual development of ancillary technologies. All critical physics and feasibility issues, however, still need to be addressed successfully in experimental campaigns ongoing at NIF in the USA and at the Laser Mégajoule (LMJ) facility near Bordeaux, France. LMJ, originally a French defence facility, will be devoting 30 % of the time to civilian research, and this would potentially open the way to a novel EU-wide research effort in inertial confinement fusion, although a LMJ-based research plan has not been presented.

From the laser technology standpoint the management maintain that a successful implementation of the ELI project is a prerequisite for HiPER, because ELI is to provide essential resources for HiPER. But ELI is a major project of its own, currently facing tremendous challenges. The time-scale involved is therefore very difficult to assess for HiPER and the current level of project definition and organisation reflects that. Still, the management maintain that construction will start in 2032, with construction costs expected to be EUR 5-10 billion over 2032-2042 and operating costs of EUR 0.5-1.0 billion per year, but it is not clear how firm such estimates are. Overall cost estimates have only been provided for the construction of the facility. No breakdown of costs during the early phases of the project prior to any construction decision was provided. No clear funding model for either the current phase or the next phase of the project seems to have been developed.

There is no evidence of commitment beyond the current phase from any potential partners. At the moment there are few stakeholders. The project management indicated that minor commitments exist from Greece and Czech Republic, with formal ministerial approval, that the French Commissariat à 'Energie Atomique (CEA) has made informally a substantial in-kind commitment to the project by making available beam time at LMJ following initial commissioning of the machine in 2015, and that a decision on the UK funding for management and governance is expected from the UK Science and Technology Facilities Council (STFC) in 2013. The STFC representative stated that STFC expects to continue to fund a major part of the EUR 1 million per year coordination and governance cost for the next few years and until the start of Horizon 2020. Successful ignition in NIF or LMJ will probably raise the number of interested parties immediately.

The management recognise that significant investment should only be considered after demonstration of proof of principle at NIF or LMJ, but maintain that through HiPER significant community building can be done in the meantime. They state that the internal project organisation and reporting structure is currently being discussed with Preparatory Phase partners. Should STFC be successful in securing funds for project management and governance until the launch of Horizon 2020, it is likely that the arrangements established within the Preparatory Phase would be continued, though extended to include industrial partners within the project. A new Consortium Agreement should make industry involvement easier.

Although the focus of the project has been changed to repeated ignition for energy production and on the gradual development of ancillary technologies, the proposers have been unable to identify deliverables and KPIs for the next few years. The KPI proposed continues to be the ultimate success of the HiPER project demonstrated when laser energy is adopted as a commercially attractive option for power generation, and the most significant interim milestone proposed remains the achievement of laser-driven ignition at NIF in the USA or at LMJ in France.

No user strategy or user policy has been presented.

Fundamental project risks with no mitigation strategies in place are that fusion is not achieved at NIF or LMJ in the next few years and the potential 'dual use' of the technology. It is also worth noting that the moment that ignition is achieved, i.e. there is a nuclear activity, then the project will be subject to the Euratom Treaty and therefore project governance, organisation and responsibilities will have to change.

Recommendations

- HiPER should be seen as a long-term research programme rather than a project for the construction of a research infrastructure in the near future. If the focus of this project is to develop such a research infrastructure, then this should be more clearly and convincingly spelled out.
- Funding after the Preparatory Phase is insecure. It is unclear what would happen if no funding from the EU came under Horizon 2020. The project should start preparing a plan for building commitment at government level for the major investment sums for the construction, even if this will be based on the energy producing potential, which will only become clear in five to seven years. An engagement policy, delivery and investment strategies should be developed.
- All financial calculations are very preliminary. The assumption that after ignition in NIF the remaining problems will be mostly technological is very optimistic. A reasonable project budget with adequate work packages for the immediate future (2013-2020) should be prepared.
- The current Agreement was planned to expire at the end of the Preparatory Phase (April 2013) and it is not clear what will happen afterwards. Regardless of what will happen in the future, the project should work on developing Governance, at least in a form sufficient to continue any project development. An Ethical Board is recommended to be included in the Governance structure in view of the risks involved in the possible dual-use of the technology to be developed.
- All general recommendations for governance (see Chapter 4) should be considered, since the research infrastructure is in the initial stages of development.
- The management should re-evaluate their project strategy to match the new focus on the gradual development of ancillary technology and provide a suitable implementa-

tion plan with deliverables and KPIs, suitable governance, a funding model and a user strategy for the immediate future (2013-2020). Development of an interim research programme around the French LMJ facility and related integrating activities might be considered.

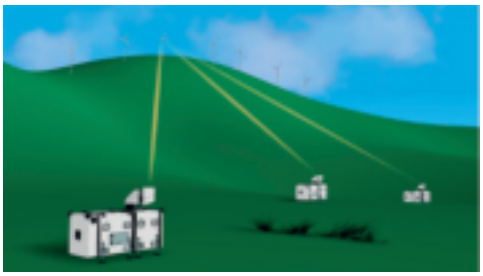
- Successful implementation of ELI is important for HiPER, yet no relationship has been clearly outlined. It is recommended that the HiPER management enter into discussions with the management of the ELI pillars about joining forces.
- One of the main tasks of the Preparatory Phase should be obtaining a clear picture of the user community and of the desirable links to other laser facilities.
- A strategy for engaging industry is important, yet is not outlined. This should be made a separate work package.
- Once a new project strategy for the immediate future (2013-2020), with suitable implementation plan, deliverables and KPIs and suitable governance, funding model and user strategy has been developed, it is recommended that it is submitted for independent (external) evaluation.

Conclusions

The new focus of HiPER remains a very long-term goal that awaits crucial proof-of-principle experiments at NIF in the US and LMJ in France and favourable results during the development of ELI; all beyond the scope of HiPER. In view of this, of the very preliminary level of project definition and the lack of any funding model, it seems that the project is trying to keep the European community aware of the strategic importance of inertial fusion, rather than truly proposing the implementation of a research infrastructure in the near future.

HiPER has clearly not reached maturity and the AEG does not consider it possible for it to be ready for implementation by 2015.

Key issues and findings



© DTU Wind Energy – Technical University of Denmark

The WINDSCANNER project has been on the ESFRI Roadmap since 2010. WindScanner.dk was funded by the Danmarks Tekniske Universitet (DTU) starting in 2009 and operates as a consortium with participation from the research institutions associated with its construction as well as from research teams within the Danish-based wind energy industry, such as Dong Energy A/S and Vestas Wind Systems A/S. It has developed a proprietary LIDAR technology for wind measurement, which will be the main asset of WINDSCANNER. The WINDSCANNER research infrastructure only entered the Preparatory Phase on 1 October 2012, so most issues have yet to be addressed. It will comprise a coordinated research programme in wind energy research, a database of wind data to help in identifying suitable sites for wind farms, a central facility/hub in Denmark and six to eight new partner nodes.

The total investment cost for seven nodes is expected to be EUR 50-60 million over three years, with the central hub cost being EUR 2-4 million. Only Denmark has made a commitment so far. Operating costs are estimated to be EUR 7+2 million per year. Cost estimates are only available as very top-level estimates. Few details were provided on the funding model. A business plan is under construction to convince the main stakeholders who may benefit by committing. The Danish node is funded at DKR 25 million (about EUR 3.35 million). The aim is to create an international network of similar centres. Capital equipment and staff investment for a single node is at the EUR 1-2 million level, though that is reportedly too high for some southern European countries.

Denmark, Netherlands, Norway and Spain have all written support letters regarding the Preparatory Phase project. For Greece, Portugal and Germany the situation is undecided at the moment. There is no commitment to the financing of the establishment of the facility, but they have agreed to be part of the Member States' Advisory Board, which has been created in parallel to the Preparatory Phase to develop commitment. The project management feel that it will be important to have Greece, Portugal and Germany in the Member States' Advisory Board. The aim is to move from a network to a real research infrastructure. Identified challenges are: the difficulty of accessing ministries (except Denmark); lack of experience with the use of structural funds to get southern European countries on board and the need to generate real money, not just in-kind. In-kind contributions will be important, but central funding is deemed to be essential.

Current plans to engage potential users beyond the institutes already involved remain unclear. Industry has not really been engaged so far, nor have airport authorities, the aerospace industry or energy ministries. WINDSCANNER will be a distributed and mobile facility ('wind tunnel without walls'). National nodes will own or rent and operate LIDAR; the central office will be there for coordination, training and servers. A single point of entry for users is envisaged. The management cannot identify a model organisation in this same area worldwide. An organisational chart is available only for the Preparatory

Phase. The legal structure envisioned is unclear. The management indicated that they have not yet studied the ERIC model, or other legal possibilities. The managers' assumption is that it is more important to develop a business plan and only afterwards start thinking about the legal structures.

Present intellectual property includes the existing WindScanner.dk short- and long-range wind scanners, their patents, their mechanical designs, functionality and technological specification documents, the integrated steering and control methodologies and existing data processing software. Emphasis often appears to be on the exploitation of specific hardware and software as opposed to establishing a true research infrastructure. No specific activity plan, staffing plan, work breakdown structure or KPIs yet exist.

When asked why a research infrastructure is envisaged instead of commercial exploitation of the equipment, the management observed that most expected customers are scientists without sufficient resources to buy the LIDARs. Reportedly, commercial operators of wind parks could also become customers, but would not be able to operate the LIDARs without help. An essential part of the research infrastructure is the software to do the 3D integration of LIDAR data and the knowledge generated. However, when asked why there is not more enthusiasm from governments, the management admitted that they still need to develop a good value proposition. In addition, the benefits of lower investment cost would fall on the public having to pay less per kW, not the government in the first place. Additional benefits of the research may be extension of lifetime of the rotors by 35 %, plus a few per cent in efficiency gain. In addition, it could help to reduce investment cost, as now uncertainty in the wind regime has been added as a safety margin in the cost of investment.

The majority of the present user community is Danish. No information was provided on how the prospective user community and the strategy on the access to the facility and to data generated will be developed.

No Risk Analysis has been performed.

Recommendations

- Arguments presented for a single research infrastructure are not yet convincing. It is recommended that the management develop the case for an infrastructure; otherwise this activity is unlikely to be funded from research infrastructure budgets. A gap analysis and a Feasibility Study of all technical options should be developed.
- The risks of financing are nearly impossible to assess at this stage. A stronger plan for engaging industry should be developed and the project should look into potential commercial partnerships and data access for commercial users with a view to exploiting the technology on a commercial basis. Possible income sources include real-time 3D measurement of wind profiles in airport landing areas and fine-tuning of planned sites for wind turbines.
- In view of the limited list of prospective partners being considered, it is recommended that a plan should be developed to identify the most promising institutional and governmental partner candidates, going beyond the limitations of the already existing academic networking. For example, the management could consider a separate work-package led by experienced policy-makers aimed at getting government commitments and developing a detailed engagement strategy, based on the energy policy targets by country on renewable energy.

- It is recommended that the proposers gather information on all legal and governance possibilities. It is advisable that they begin this as soon as possible. For the future it is recommended to incorporate an Ethical Committee in the governance structure. In general the future governance development should empower the Director as much as possible.
- All general recommendations for governance (see Chapter 4) should be considered, since the research infrastructure is in the initial stages of the development.
- A detailed activity plan should be developed to clarify the added value represented by WINDSCANNER in terms of scientific, technical and technology transfer deliverables and as a distributed research infrastructure, as opposed to a set of individual participating institutions. This will require developing Delivery and Investment strategies. It is recommended that measurable and credible KPIs for the project as a whole be developed to monitor and gauge success in the different areas envisioned, such as coordinated research programmes in wind energy research, a wind database and peer-reviewed open access. KPIs will also be important to attract new partners/investors.
- In the USA dual LIDAR measurement systems will possibly affect and compete with the project's long-range scanning wind LIDARs currently under development. Although the present IP developed by WindScanner.dk is an important asset, it is recommended that the research infrastructure documentation indicates that the long-term plans are device-independent and will exploit the best and most convenient technology that may be developed anywhere, if establishing a true research infrastructure is the real target.
- A more vigorous approach to engaging a scientific community wishing to use WINDSCANNER is essential for success. One of the main tasks of the Preparatory Phase should be to develop the user community, define the data access policy and introduce convincing user-related KPIs.
- A risk table needs to be developed. Since the LIDARs to be used are a new development, the risks (cost, schedule, reliability) should be explained and assessed.
- Once an activity plan, business plan, KPIs, governance and user-access model are developed, it is strongly recommended that they be independently evaluated. An independent scientific and technical review and an independent project cost review, taking also into account risks, seem essential to reach an investment decision. Only a positive result of such reviews would show that a project implementation phase could be successful in cost, schedule and performance.

Conclusions

The WINDSCANNER project only entered the Preparatory Phase only on 1 October 2012, and almost all issues have yet to be addressed. Information on the next steps to be taken and general strategies to be pursued is very limited at this point. Several very critical aspects should be investigated in depth during the Preparatory Phase. Once sufficiently developed, the project will need a new independent evaluation.

WINDSCANNER has clearly not yet reached maturity under any aspect and the chances that it will be ready for implementation by 2015 are considered minimal.

3.4 Biological and Medical Sciences

ANAEE — Infrastructure for Analysis and Experimentation on Ecosystems

Key issues and findings

The four complementary components and their associated analytical and modelling platforms

ANAEE is a distributed experimental infrastructure enabling ecosystem research. It has been on the ESFRI Roadmap since 2010. A coordinated set of experimental platforms across Europe will analyse, test and forecast the response of ecosystems to environmental and land use changes. It is a research infrastructure at an early stage of development, and it has just entered the Preparatory Phase. Therefore it was not possible for the managers to answer many of the questions in the AEG Questionnaire.

Only overall costs are provided. There is information on the partners in the Preparatory Phase, but not of the proposed funding model, although the project management hope to have membership fees that will cover access costs. There is no information about feasibility, Business Case Review, auditing of accounting and budget system. Regarding investment decisions and their implementation, it is planned that each member country will put the money aside to invest and make it available under the ANAEE umbrella. In France there is an ongoing call for proposals, and in the UK soil centres are to be selected. However, at the date of the interview there were no commitments by the French or the UK governments to sign an ERIC or a related MoU. In the Preparatory Phase grant, agreement partner institutes from 10 countries received support by the European Commission. Letters of support by 10 countries are quoted, but could not be verified. Information on the possibility to use ERDF has been given to countries that are eligible for it.

There is a governance structure for the Preparatory Phase with a steering committee involving 13 institutions and one funding agency. No statutes or detailed governance structure have been proposed yet for the implementation phase. Members of the executive committee/legal and financial board will be defined after the Preparatory Phase. No KPIs have been defined.

Mission and vision is to be determined in the Preparatory Phase. The goal of the research infrastructure is to become a mission-orientated agency solving major problems for society. At present, 21 staff work for ANAEE and work package leaders have been nominated by France and the UK.

No explicit information on stakeholders has been given. Since the preliminary phase work is divided between several institutes in environmental sciences, it is likely that funding agencies or ministries and research institutes could be stakeholders.

Potential users are environmental scientists and social scientists. Policy makers can also gain access to the data, develop models and make policy. At the European level there is an estimate of approximately two thousand users. Potential users of the infrastructure will have to write proposals to be peer-reviewed. Access to the infrastructure is foreseen to be restricted for an initial period, with public access to be allowed later. Access modes for potential industrial users have not been considered. There are worldwide connections (to Brazil, South Africa and Australia), with global connections to international Global Climate Change programmes. Data handling and data access have not yet been addressed.

No real risk assessment has been prepared — that is in fact difficult at this stage — but provisional risk information has been provided. This information is related to commitments from Member States, representation in work package six and regarding changes in global economic situation.

Recommendations

The project is at a very early stage of definition. The project management need to better define the scope of the central activity versus distributed activities and how all of these will be funded (for instance through membership contributions).

- The AEG considers it essential to secure financing by a significant part of the still undefined stakeholders. Stakeholders should be identified very soon; otherwise no progress is possible on the ambitious goals of the project.
- The management declared that they plan to keep the national nodes as part of the project and will take responsibility for their activities and development (including investment decisions). This seems a very ambitious goal that should be addressed in the careful negotiations with prospective stakeholders that will have to take place during the preliminary phase. It is worthwhile pursuing this, as it is a condition for ANAEE to go beyond a networking and access programme. If it is not possible to include the national nodes in the research infrastructure, clear service level agreements should at least be concluded.
- Another ambitious goal, linked with the previous one, is that ANAEE will strive to achieve synchronised and unified national decision making to facilitate the foreseen construction planning. This will need to be properly defined in the statutes of the legal entity eventually selected.
- Development of statutes is one of the essential next steps. It is worth mentioning that since environmental research touches many critical fields, it might be advisable to foresee an Ethical/Bioethical Committee in the statutes. Methods to protect IP will also have to be developed and should be foreseen in the statutes.
- Since the research infrastructure is at a very early stage, general recommendations for Governance (see Chapter 4) should be considered, especially those concerning the negotiation on governance and legal issues.
- A major challenge recognised by the management is that there may be some difficulties in gaining consensus between the different communities as to the governance structure. In terms of securing funding, the main bottleneck is that national funding is dependent on national policy, which may for financial and/or economic reasons decide to invest (or not) in a European infrastructure. It seems therefore urgent that a more

detailed activity plan with suitable deliverables and project-wide KPIs are developed, to present a reasonable and convincing offer to prospective funders.

- ANAEE recognises that it should engage relevant funders and ministries from the Member States at an early stage in the development of the research infrastructure. This is best done through a dedicated work-package led by someone at senior level with diplomatic skills and an understanding of the politics involved.
- A user strategy, which includes access to, handling and addition of data should be defined soon during the Preparatory Phase.
- The relationships with ICOS and LIFEWATCH should be clearly developed.
- A Risk Report dealing with the specific risks of the infrastructure should be prepared. In particular the organisation, decision-making processes and the ICT system would deserve a detailed risk analysis.
- Once an activity plan, business plan, user strategy and KPIs are developed, it is strongly recommended that they be independently evaluated. An independent scientific and technical review and an independent project cost review, taking also into account risks, seem essential to reach an investment decision. A positive result of such reviews is essential to show that a project implementation phase would be successful in cost, schedule and performance.

Conclusions

The infrastructure is still very early in the Preparatory Phase and not mature at this point in time. The recommendations show several issues to be resolved before the infrastructure can reach the implementation phase, the main issue being the insufficient financing due to a low number of stakeholders.

The tasks that are ahead of the infrastructure team normally need a lot of time to be completed and the chances of achieving maturity by 2015 are considered minimal at this point.

BBMRI — Bio-banking and Biomolecular Resources Research Infrastructure

Key issues and findings

BBMRI is a distributed research infrastructure and has been on the ESFRI Roadmap since 2006. It is mostly a networking and standardisation effort, whose stated mission as an ERIC is to increase efficiency and excellence in European biomedical research in an ethically and legally compliant way, and to promote standard operating procedures and international best practices on a variety of pre-existing national bio-banks. The National nodes are not part of the ERIC. The relation to the central entity is achieved via membership on the Management Board, thus national bio-banks have only an indirect link to the ERIC. This is reflected in the Partner Charter with the national nodes.

BBMRI includes a sample storage infrastructure. See here a hermetic semi-automated cryo-storage system.

In the ERIC application, EUR 140 million are said to have been already committed by 14 countries to establish the national nodes and EUR 2-3 million per year to operate the ERIC. Austria, Bulgaria, Czech Republic, Estonia, Finland, France, Greece, Italy, Latvia, Malta, Netherlands, Norway, Spain and Sweden have signed the MoU. The minimum requirement for the central organisation is EUR 1 million (i.e. eight countries would be sufficient). The research infrastructure management expects to start with 14 members and build from there (as stated in the presentation). Additional members would bring additional funding, which would enable capacity building, training and data management. There seems to be a high level of commitment in the scientific community as well as political commitment. However, the security of the commitments to fund the construction and operations of the central facility remains in question.

Later years of the business plan identify additional funding for central or common activities. In the centralised budget there is almost no capacity for implementing the ERA and other common strategic goals. The project is looking into whether some budget could come from Horizon 2020 to promote the common EU vision, through a competitive mechanism.

On the issue of gap analysis and getting members to invest national funds in gap areas, the project accepts that this is difficult to control. Individual nations want to invest in this new field and there is some competition between the different countries, including industrial involvement, which might have some positive effects. The management stated that all countries understand that they would waste money in duplicating other countries' efforts. While standards and data quality criteria have to be the same, capacity building can be competitive. The management's position that they cannot and will not interfere on national decisions or processes concerning investment priorities, national procurement and human resources may be seen as an important limitation to the ultimate significance of the research infrastructure at the European level.

Not surprisingly, ethical issues and bodies related to it are addressed. However, the SEAB (Science and Ethical Advisory Board) as a 'joint body' dealing with science and ethics at the same time may not be the best solution. The question arises as to how independent the SEAB is, and what is its exact relation to the Scientific Review Board and the Ethical Review Board. Also mentioned is the Framework for honouring Ethical Issues. Ethical and Regulatory issues are also dealt in the expert centres.

The ERIC statutes are well developed and the role of Director-General has appropriate powers.

The business plan contains a thorough plan of the user community and a data-access policy exists. IPR will be handled on a case-by-case basis, but the user community is in principle well-defined and peer-review issues are addressed. BBMRI has developed an interesting mechanism for allowing industrial users to make use of the research infrastructure, without disclosure of privacy or sensitive personal data. This could be of interest for similar research infrastructures.

The ERIC application for BBMRI contains reasonable proposed procedures for handling legal matters and staff hiring.

BBMRI can be considered to be a kind of 'tool' for risk assessment of preventative measures against emerging pathogens. Furthermore, biosecurity solutions are mentioned to prevent dual-use of biological materials at bio-banks. However, this is probably only one kind of risk and the 'risk mitigation' strategies in a wider sense are not fully described.

Recommendations

- While the project cannot control national investments, it can control which investments are accepted as part of the distributed infrastructure. It is important to avoid duplication. Other assessed research infrastructures have defined a requirement and then issued a call for proposals (even where national funding would provide the infrastructure). BBMRI should consider being more proactive in this area.
- Responsibility in governance and possible legal issues should in some cases be clearly indicated in the documents. The fact that the General Assembly supervises the Director-General should be clearly underlined in the statutes and papers.
- Transparent procedures for nominating and appointing Scientific and Ethical Advisory Board SEAB members should be addressed.
- The possibility of separating the ethical and scientific aspects in SEAB should be looked into. This is a way of avoiding controversies.
- A more well-defined structure for ethical responsibility and a hierarchy of responsibilities would be welcome. There are quite a few bodies listed, but it is not clear who is responsible to whom and for what exactly.
- Efforts should be made to bring prominent UK and German institutions that participated in the Preparatory Phase back into the fold.
- A clear definition of the activity plan and a plan for its implementation with connection to the KPIs should be developed. Reportedly, a number of parameters to monitor productivity have been identified together with Technopolis, but true target values, i.e. KPIs for the project as a whole should be identified.
- Once an activity plan, implementation plan and suitable KPIs are developed, it is recommended that they be independently evaluated, in addition to and in parallel with the standard ERIC assessment by the European Commission.

- To strengthen the European research infrastructure role, BBMRI should consider strengthening the role of the ERIC by establishing contracts between the central hub and the nodes, including binding rules for the enforcement of the Partner Charters. This would pave the way to ensuring the division of labour, avoidance of overlaps and increase efficiency in procurement.
- A solid strategy to ensure financial sustainability should be developed, involving governments and funding agencies at high level, managed by someone with policy skills. This is a work-package in its own right to develop an overall Investment Strategy.
- At present not all European bio-banks are on board, the efforts to make this happen is strongly encouraged. BBRMI also has an important role of quality control and definition of standards for the samples. The latter should be seen in an international context. It is recommended that the contacts and collaborations with other research infrastructures in the field be developed for the benefit of the user community.
- A detailed Risk Report should be developed. The mentioning of biosecurity is a proof that there are risks, and this opens up the necessity to compile a more detailed risk register and to assess their possible impacts.

Conclusions

BBMRI has been on the ESFRI Roadmap since 2006, and at this point in time it could be said to be well on the way to achieving maturity. Focused efforts should be made in strengthening the European research infrastructure role, especially by strengthening the role of the ERIC and developing clear relationships between the central hub and the nodes. Special effort should also be made in order to get on board as many European bio-banks as possible since BBMRI plays an important role in quality control and defining standards for samples. Addressing risk and ethical issues in conjunction at European level would ensure that security measures are dealt with in adequate ways, as well as providing ways of dealing with unwanted incidents.

If the AEG's recommendations are followed then BBMRI could reach implementation by 2015.

EATRIS — European Advanced Translational Research Infrastructure in Medicine

Key issues and findings

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EATRIS aims to provide access to a top-academic high-end infrastructure and related academic services for research, translational research expertise and large patient cohorts. EATRIS is expected to facilitate the efficient translation of novel biomedical targets into the development of innovative preventive, diagnostic and therapeutic products, including their early-stage clinical evaluation in a coordinated effort to address the 'innovation gap' that afflicts both industry and academic science worldwide. The ten countries currently involved are Czech Republic, Denmark, Estonia, Finland, France, Germany, Italy, the Netherlands (host), Norway and Spain.

EATRIS has been on the ESFRI Roadmap since 2006. The EC funded Preparatory Phase ended in 2010. EATRIS is expecting to be able to provide more details on the national financial figures in the course of 2013, and is currently preparing the key documents, that are a prerequisite to start the operations: the EATRIS Framework Agreement (EFA), IPR policy, the Quality Assurance and Project Manual, ethical principles, data and privacy principles and the project agreement template. The target of EATRIS for 2013 is to have these papers signed, decide on the partners, become an ERIC and establish external advisory boards etc., so that the main aspects of the project will be defined in 2013. In the proposed overall Governance structures, some segments are quite complex, such as the membership rules and the matrix structure for the management. Experience shows that this model requires that the 'project-axis-leaders' have sufficient say over the 'service columns'. However, for this matrix to function, adequate resources and mechanisms for service level agreements are missing. The procedure for the appointment of members of Science Advisory Board still needs to be discussed and a consensus reached.

The EATRIS leadership has developed a novel and original operational model with networking and standardisation as an important by-product. According to the management however, there are no examples of large-scale success of this model anywhere else in the world. Much of the activity will take place in the national EATRIS nodes and institutes and in the projects (20 active translational projects is the initial goal). Relationships with national nodes will be legally organised through a Framework Agreement. Funding of the central node will be via a host contribution plus membership fees. There is a need to extend membership to achieve the necessary level of funding. The eventual aim is to become independent of subsidies, i.e. operate on the basis of full cost funding by clients. A full business plan still needs to be developed. It is difficult to comment on the financial planning without this.

KPIs are proposed, but could be improved. The number of projects and the number of platforms to be activated by 2017 says very little about the size and quality of the

projects and platforms and the effective functioning of the central services. Implementing a strategy to establish credibility with clients, while not taking responsibility either for the quality or for the timing of the services offered by the platform, will be a major challenge. Relying on self-certification without establishing an EATRIS certification or an EATRIS validation of the EATRIS platform will carry a reputational risk to be evaluated. If EATRIS wished to carry out this certification, the staff currently employed in the Central hub would not seem sufficient.

Relationships with other biomedical projects such as ECRIN, EU-OPENSCREEN and BBMRI are mentioned, but not further developed.

The users of EATRIS are clients coming from academia, industry and funding bodies. The business plan to be developed may contain some information on the potential user community, but currently this analysis is incomplete. The data access policy will be defined as part of the agreement on the collaboration. The user-related KPIs are loosely defined and not directly related to the activities of the clients. Some thoughts have been given to this aspect. The implications of the commercial nature of projects will require further consideration, including a sound analysis of the national regulatory framework of the commercial environment.

EATRIS itself is meant as a 'tool' to reduce unexpected risks for industry and society, so it is a 'risk mitigation tool' by itself. From the available documentation, however, it is not fully clear how this would work. The structure of EATRIS is rather complex. It will require more time than other structures to be implemented. This is a risk for the schedule.

Recommendations

- Given the novel and experimental character of EATRIS as a research infrastructure, the evolution of the expected commitments should be carefully monitored. If expectations are not met during the course of 2013, an alternative Business Case should be put in place.
- In order to build the client base, EATRIS should consider organising brokerage events to engage users and clients and to monitor and publicise successful examples of EATRIS added value. At the same time EATRIS should verify, via adequate surveys, the perceived value added of the central hub. A careful gap analysis should be undertaken.
- Governance should be looked at again and adapted to the scope of EATRIS. Special attention should be given to lines of responsibility within the matrix model structure. Transparent procedures for nomination and appointment of SAB members should be developed. In finalising ethical regulations, a separate committee or board for ethical issues should be considered, since ethical compliance at the level of each institute or each project may not prove to be adequate in all cases.
- An Investment Strategy should be developed to ensure that with new investments expected by the Member States in the upcoming years, EATRIS institutes will upgrade their service and quality levels continuously and will be embedding the strategic decisions of the Board of Governors in the individual institutes in each Member State. This should preferably be included in the EFA.
- Once KPIs are identified to monitor and assess project success, it will be important to perform credible external reviews of the different aspects, technical, financial and recruiting-related items. This might be complicated in view of the network character of the project, but internal boards are not sufficient. In particular, the external reviewers should assess project management and make sure that sufficient power is delegated

to the project managers so that they can react promptly to an evolving situation and influence the decisions of participating institutions. The above-mentioned independent review could be scheduled following the completion of the business plan.

- The agreements that will be signed for the addition of each institute or platform to EATRIS should be an occasion to influence each institution to follow EU best practice procedures for quality assurance, recruitment, procuring, HR policy etc. Without this European dimension, it will be difficult for users to accept the added value of EATRIS.
- This research infrastructure should develop a risk assessment list. This should include data protection risks. The fact that EATRIS is a 'risk mitigation tool' by itself should be reflected in the risk assessment list.

Conclusions

EATRIS proposes an interesting novel model to close the innovation gap between academic research and industrial applications. EATRIS expects that in 2013 decisions on an ERIC will be taken and all documents will be signed in September. Financially, EATRIS aims ultimately to be independent of subsidies. The funding model relies on a sufficient number of clients willing to pay the cost of the services of EATRIS. This will require considerable marketing effort. It is strongly recommended to have an independent external review once all documents are available.

If all this is successfully completed and all other recommendations of the AEG are successfully acted on, it is considered possible for EATRIS to achieve implementation by 2015. Much depends on whether the expected accomplishments in 2013 will be realised.

ECRIN — Pan-European Infrastructure for Clinical Trials and Biotherapy

Key issues and findings

ECRIN is a distributed infrastructure supporting multinational clinical research. It also aims at structuring the clinical research capacity at the national and European level. ECRIN has been on the ESFRI Roadmap since 2006. The current level of financial commitment comes from the contribution of the five founding members (France, Germany, Italy, Portugal and Spain), which represents an annual contribution of EUR 1.7 million.

A total of 14 countries participated in the Preparatory Phase, but only five are ready to sign the ERIC. Their contribution is expected to provide enough money to fund the core activities and the European Correspondents. These will be located in each national hub and act as contact points for the whole network, in charge of structuring activities, coordinating the provision of information and servicing multinational clinical projects. When new countries come on board, the management intends to use 50 % of their contribution to increase core activities, while 50 % will be used to reduce the contributions of current partners. Each new country will have a European Correspondent, but the ECRIN management state that a more pragmatic approach may be needed in future and efforts should be placed where needed. To cover the requested services from ECRIN, each individual project will also bring its own budget. Contracts will be between the sponsor of the study and the ERIC, and the cost of the trial will be covered through contracts between the trial sponsor and the provider. The plan is for the European Correspondents to be paid by the ERIC and generally to be employed by the ERIC. The managers maintain that there might be exceptions where they are employed locally or provided as in-kind contributions and that substantial interest has been expressed by new members, such as Turkey. The aim is to have as many countries as possible, and they are looking at ways to make the ERIC membership more attractive to potential members.

Statutes, governance and legal bodies are well structured and thought out. It is noted that ECRIN will have an Ethical Advisory Board, which is especially important considering the nature of the project.

The project management and the staffing plan appear reasonable, provided that there are effective interactions and collaborations between the national member organisations and individual hospitals/institutions. Negotiating certification of the different participating national centres seems a very sensible way of guaranteeing standardisation

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and a European dimension. The proposed evaluation parameters are the number of clinical studies submitted to the infrastructure, the number of clinical studies supported by ECRIN-ERIC, the satisfaction of the users and numbers of users who will come back to the infrastructure to support their international clinical research and the publication record. Such parameters appear reasonable, but target values for such parameters have not yet been identified as facility-wide KPIs.

The links to the national centres are established by contracts (Article 5.1), and the European Correspondents are under central management.

The users are academic investigators, academic networks, scientific associations, academic sponsors such as hospitals or universities, disease-orientated networks and SMEs in the field of medical devices or biotechnology enterprises. More rarely it will be the pharmaceutical industry, and usually within a public-private partnership. There seems to be some uneasiness about the role of possible industrial sponsors and no strategy has yet been proposed to develop the industrial potential of ECRIN.

A thorough risk analysis was not presented. Risk is mentioned in a vague way without referring to the specific type of risk. The risk for patients to participate in a clinical trial study is mentioned but without possible consequences or possible risk mitigation as e.g. conceivable insurances for financial damages. One should also be aware and pay attention to the sources of risk associated with data protection and e-infrastructure, from viruses, falsifications to privacy violations and catastrophic data losses.

Recommendations

- A detailed Engagement Strategy to bring a larger number of countries on board should be developed. This strategy should aim at examining and eliminating barriers and bottlenecks that could obstruct the membership of the ERIC. The possibilities for non-ERIC signatories to participate in the ERIC should be considered.
- A method to demonstrate the value added by ECRIN and to recruit more participants could be to define proof-of-principle projects that can engage the potential user community in academia, SMEs and patient groups.
- The proposed evaluation parameters appear reasonable, but target values for such parameters should be identified to derive project-wide KPIs to be monitored during operation.
- It is recommended that a couple of examples of project organisation for ongoing multinational trials are monitored and subjected to an independent external assessment to verify that the central organisation is sufficient when supported by the national nodes.
- The certification documents that will be signed for the additional national centres should be an occasion to influence each institution to follow EU best practice on procedures for recruitment, procuring, HR policy, etc.
- Care should be taken to minimise the cost increase that may come from splitting any procurement of general ECRIN-ERIC interest into several individual national or institutional contracts.
- It will be important to perform credible external reviews of the different research infrastructure aspects (technical, financial and recruiting-related). This might be complicated in view of the network character of the facility, but internal boards are not sufficient. In particular, the external reviewers should monitor the result of the ERIC in terms of project management and make sure that sufficient power is delegated to the management to influence the participating institutions' decisions and assess

how efficient the actual interaction between the central organisation and the national nodes is.

- ECRIN seems to have the ambition to evolve into a funding agency. The potential consequences of such a development should be carefully considered.
- There seems to be some uneasiness about the role of possible industrial sponsors, but this could be an important avenue for expanding the ECRIN-ERIC activities and influence in the field. A strategy for the development of the industrial potential of ECRIN should be identified and pursued.
- ECRIN could benefit from close collaboration with a number of other biomedical research infrastructures. This should be an explicit action.
- A thorough Risk Analysis should be performed. The ECRIN-ERIC statutes should clarify all risk issues with a clear specification of the type of risk. The appointment and assessment by a Scientific Board could be considered as a mitigation strategy.

Conclusions

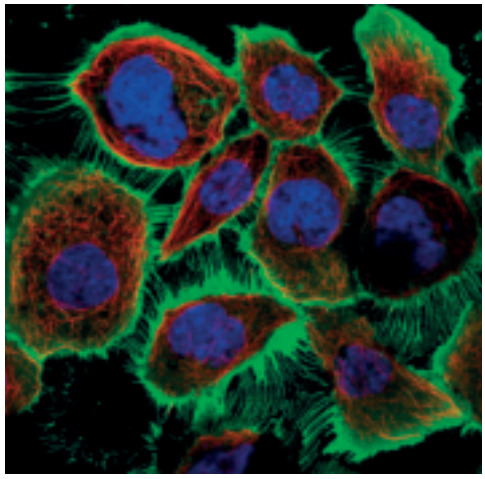
ECRIN has been on the Roadmap since 2006, but while a total of 14 countries participated in the Preparatory Phase, only five countries are currently ready to sign the ERIC. A detailed Engagement Strategy to bring a larger number of countries on board needs be developed.

However with focused efforts and if the AEG's recommendations are followed then implementation by 2015 is possible.

ELIXIR — Upgrade of the European Life-science Infrastructure for Biological Information

Key issues and findings

ELIXIR aims at building an effective data infrastructure for biological information that will encompass hundreds of existing biological databases in Europe, ranging from major core datasets — such as the vertebrate genomes in Ensemble — to very small specialist collections overseen on a part-time basis by individual researchers. ELIXIR has been on the ESFRI Roadmap since 2006. It is coordinated by EMBL's European Bioinformatics Institute (EBI) in the UK that serves as the central hub for ELIXIR. The present membership includes Czech Republic, Denmark, Estonia, Finland, Israel, Italy, Netherlands, Norway, Portugal, Slovenia, Sweden, Spain, Switzerland and the UK.



Immunofluorescent staining of A-431 epidermoid carcinoma cells shows positivity in plasma membrane.

Figures provided for the ESFRI 2010 Roadmap indicated that the construction costs of ELIXIR, referring both to the hub and the nodes would be EUR 470 million, with annual operating costs of EUR 100 million per year. As more countries join ELIXIR, including some from outside Europe, the overall size, shape and therefore cost of the infrastructure is going to increase.

The construction of the ELIXIR Hub is being funded by the UK, which will become the host country. Several countries have made firm commitments for the development and operation of national ELIXIR nodes. The central hub funding covers central hub functions as well as some activities in the nodes. The hub budget is very lean compared to the funding for the national nodes.

The establishment of an ELIXIR consortium agreement is in progress. The agreement will define the role of EMBL (EBI) in the management of ELIXIR by using its legal personality and the existing administrative facilities of EMBL. An important step is the appointment of the Director, who is due to start 1 May 2013. The nodes representing national centres of excellence in bioinformatics are selected on the basis of proposals that are reviewed by the Scientific Advisory Board (SAB). The material provided shows that ELIXIR has a very independent SAB that carries out reviews of new proposals with strong recommendations.

ELIXIR can be considered a networking effort between national nodes with the addition of a major (EUR 100 million) UK-funded new hub, with each of these facilities operating according to national rules. The influence of the central hub over the national nodes, e.g. in terms of being able to influence investment decisions and imposing standards, at present is limited. An extensive list of parameters has been selected to monitor impact, but it should be emphasised that the target values of such parameters have not yet been identified as KPIs for the project as a whole. Eventually the Collaboration Agreements

will set out the exact services which each node will provide and the relevant KPIs are expected to be developed out of these collaboration agreements.

ELIXIR has a large and growing user community that extends beyond the user community of the EBI (EMBL). It includes users from academia, the environmental sciences and industry. The user survey carried out in the Preparatory Phase has given an insight into the needs and priorities of the users. Access to data is free to users from academia. Some controlled access is allowed for industry, at conditions accepted by industry, which is an important stakeholder. ELIXIR has taken a leading and very important role in the coordination of activities of the ESFRI biomedical research infrastructures, by leading the EC-funded BioMedBridges project.

ELIXIR has a general risk assessment (risks considered as existing, but low) and a special risk assessment for the central hub in Cambridge. The major risk of ELIXIR is in the data protection, on which it can be concluded that this risk is taken properly into account.

Recommendations

- The national nodes are accepted as part of ELIXIR after application and service agreements have been concluded with the central hub. However, these agreements are not sufficient to achieve the ambitions of ELIXIR as a European research infrastructure. ELIXIR should not only make use of the available investments and commitments, but also be able to influence them in order to ensure standardisation, avoid overlap and optimise investment decisions.
- Clarification of the double role of EMBL as partner and contractor seems necessary. Plans for a stronger long-term financial relationship with Member States and national efforts should be considered. It should also be considered whether a future move to ERIC is realistic, or if the present legal framework is sufficient in the long term.
- The nodes have the basic responsibility concerning ethical issues but an overarching Ethical Board is recommended, especially in the area of data-access policy, where both ethical and data-protection issues should be taken into account.
- The selection of the nodes takes place in a bottom-up process. It is recommended that the SAB carries out a top down-analysis to identify possible gaps in the infrastructure.
- It is important that project-wide KPIs are identified, *inter alia* as a tool to demonstrate added value and bring more partners on board. The current bottom-up approach should be complemented by a top-down SAB analysis of what the project as whole wants to achieve in terms of science and societal impact.
- The organisation of the long-term funding should be treated as a work-package of high complexity, led by an experienced science policy-maker. Given the wide range of user communities that ELIXIR would like to serve, it is essential that a dedicated work-package is also put in place to achieve this ambition. Getting the central data role of ELIXIR accepted outside of the traditional EMBL constituency will take time and effort. Given the expertise of the ELIXIR partners, this is a worthwhile effort.
- Because it is the coordination role of the hub that makes the research infrastructure function, a plan to gradually strengthen the hub functions should be developed, involving as much as possible the nodes from the start to avoid nodes seeing stronger hubs as a threat.
- The current emphasis on the 'soft influencing' of the nodes should gradually give ground to a more structured approach to organise procurement and recruitment in order to maximise the project impact while minimising costs. An international pro-

curement coordination task force might be envisioned to contain costs, instead of handling the quoted EUR 470 million procurement node by node.

- Once an activity plan and the related budget breakdown are developed, it is recommended that they are independently (externally) reviewed. The external audits that are expected as part of the normal annual external audits of the EMBL project will not take care of that.
- ELIXIR should continue and further develop its leading role in coordinating all biomedical research data-related activities leading to improved facilities for the users.

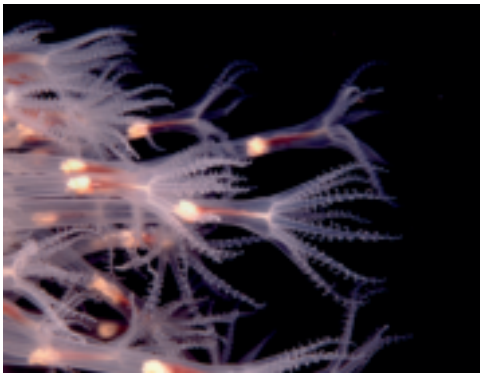
Conclusions

ELIXIR has been on the ESFRI Roadmap since 2006. It is strongly linked to the EBI outstation of EMBL in the UK, which serves as the central hub of the project. Because it is the coordination role of the hub that makes the research infrastructure function, a plan to gradually strengthen the hub functions needs to be developed. ELIXIR should not only make use of the available investments and commitments, but also be able to influence them in order to ensure standardisation, avoid overlap and optimise investment decisions.

However if the recommendations of the AEG are followed ELIXIR should be ready for implementation by 2015.

EMBRC — European Marine Biological Resource Centre

Key issues and findings



Model organism: Veretillum cynomorium, CCMAR - Centre of Marine Sciences (University of Algarve). © Peter Wirtz

EMBRC (European Marine Biological Resource Centre) is a distributed research infrastructure uniting leading marine research stations across Europe. Italy, France, Germany, Greece, Norway, Portugal, Sweden and the UK are involved as partners. It has been on the ESFRI Roadmap since 2008. The Preparatory Phase runs from 2011 to April 2014. An MoU is under development and there has been a unanimous decision to go for an ERIC or an ERIC-like legal structure for the EMBRC core, which will be separate from the nodes. It is expected that the relationship between the core and the nodes will be clarified in the final statutes, with the intention that the nodes maintain their legally autonomous state. During the Preparatory Phase, technical, legal, governance and financial issues will be addressed to prepare the MoU enabling the implementation of EMBRC. EMBL, France, Italy, Portugal, Greece and Israel will most likely sign the MoU. The project management expects the governance and legal structures to be in place by 2016.

There has been an open call for bids to host the EMBRC Headquarters, which are to be quantitatively evaluated. ERDF could be included in this process. The project management hopes to know the size of the financial commitment and therefore the scope of the research infrastructure by the end of 2013. The EUR 125 million quoted investment costs of EMBRC on the Roadmap corresponds to 100 % of the node investments expected in the coming five years.

In the documentation submitted, there is a good top-level breakdown of core costs for this stage of the project. The funding concept is under discussion with a proposal for host contribution plus membership charge. Based on the functions of the core, the estimated operating costs of the core secretariat are slightly less than EUR 1 million per year during the Construction Phase. The building and its related infrastructure are expected to be covered by an in-kind contribution of the host country. The costs of construction and operation at each of the national nodes are the responsibility of the individual Member States under the subsidiarity model chosen for EMBRC, following consensus of the partners. No decommissioning costs are foreseen so far since the upgrading and maintenance costs will be mainly under the responsibility of the owners of the nodes.

It should be kept in mind that the entirety of the research infrastructure must function as an entity, which requires special attention on the relationship between the ERIC structure and the nodes. At this point it is not clear how the statutes are going to deal with this issue. On the one hand the managers state that the core office will be a lean coordination structure connected to legally autonomous, national hubs and local nodes. On the other hand they see the added value of the research infrastructure EMBRC in the integrated multinational planning and operation of existing and novel national research infrastructure (equipment, platforms, technologies and human resources) to optimise

sustained service provision to European end users. This necessitates a stronger role of the core office than is currently foreseen, although the Director proposes to be quite independent and powerful.

There are no plans to develop an in-house marine research strategy, reportedly because the EuroMarine project has already developed a strategic plan for marine research. The 20 % of the node activities devoted initially to EMBRC were stated during the interview to be for I3-like user access. The main difference between EMBRC and a permanent transnational (I3-like) programme was quoted during the interview as the fact that EMBRC will design and implement strategic plans for developing new instrumentation and facilities. The project management expect that implementation of the strategy will depend on how the Director can talk to the Directors of the national nodes. An implementation plan does not yet exist, once this is the case, the intention is to develop work breakdown structures and KPIs.

EMBRC has a well-established user community that originates from the FP7 ASSEMBLE project. The proposers plan to use similar procedures as those implemented in ASSEMBLE to regulate user access. Open access at full economic costs is foreseen as the access model for European non-commercial users. Ethical issues are expected to be dealt with at the national level. A model for commercial users was reported to be under development. The users of EMBRC are also users of other research infrastructures, and through the BioMedBridges FP7 programme collaborations with other related projects (LIFEWATCH, ELIXIR, Euro-BioImaging, EMSO, EURO-ARGO and INSTRUCT) are reportedly being explored. It is important to have these contacts formalised through cooperation agreements.

A short list of estimates of (organisational) risks has been prepared, and the project management expects to have a full risk management plan and quality assurance system ready in July 2013, although it appears that risks connected to the Information and Communication Technologies will not be included.

Recommendations

- Commitments to the long-term funding of the central office appear to be weak at present, as is the engagement of governments and national funding agencies in the setting up of the central structure. It is recommended that a structured plan for raising the necessary funding should be established and led by people with the appropriate political skills.
- The management states that the ERIC legal structure will be separate from the nodes. In order to qualify as an integrated research infrastructure, strong links between the central nodes and the core are required, otherwise EMBRC will mainly be a networking activity and access programme. Special attention should be given to the relationship between the ERIC structure and the nodes, with a high priority on the development of a suitable interaction model between the ERIC structure and the nodes.
- The influence of the Director with regard to the nodes should be clearly spelled out in order for the research infrastructure to function efficiently as a whole.
- A separate Ethical Board should be considered to go beyond the planned reliance on national regulations.
- It is urgent to develop a technical activity plan with appropriate work breakdown structure and KPIs. Priority should be given to this and to the other milestones yet to be produced: finalisation of the business plan, signing of the MoU defining the statutory seat, partners, voting rights and membership fees, development of the con-

struction phase strategy, implementation of the core, implementation of marketing strategy. It seems that a very substantial amount of work still needs to be done, at this stage where the Preparatory Phase is coming to a close.

- Project deadlines should be re-evaluated and progress carefully monitored to make sure that the deadlines are met.
- When a business plan, work-breakdown structures, user-access model and KPIs have been developed, they should be subjected to an independent scientific and technical review and an independent cost review, also taking into account risks. A positive result of such reviews is essential to show that an implementation phase would be successful in cost, schedule and performance.
- EMBRC is engaged in discussions on cooperation with other relevant biomedical and environmental research infrastructures. The cooperation aims to enhance complementarity and to share resources with these related facilities. These valuable collaborations are encouraged; however it is important that the relationship between the core and the nodes are clarified prior to any formalisation of the collaboration agreements with other research infrastructures.
- An improved risk report needs to be prepared once the relationships between hub and nodes are clarified and defined in the by-laws so that the organisational risks can be assessed.

Conclusions

EBMRC is approaching the end of the Preparatory Phase, but several important organisational matters remain to be sorted out, in particular the relationships between the EMBRC core and nodes. Strong and well-defined relationships between the core and the nodes are essential for EMBRC to develop beyond a networking activity.

However with significant, focused efforts and if the recommendations of the AEG are successfully addressed, then implementation by 2015 could be achievable.

ERINHA — Upgrade of the High Security Laboratories for the study of level 4 pathogens

Key issues and findings

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ERINHA was on the 2008 ESFRI Roadmap as 'European High Security BSL4 Laboratories', then from 2010, on the Roadmap as ERINHA, with the same EUR 174 million construction costs (2010-2013) and EUR 24 million per year of operating costs. ERINHA is an open, distributed research infrastructure. The mission of ERINHA is to develop and operate a distributed European research infrastructure in order to strengthen European capacities in the fields of diagnosis and study of highly pathogenic infectious microorganisms. Partners in the Preparatory Phase are France, Germany, Italy, Sweden, Hungary, Romania, UK, Greece, Spain, Portugal, Belgium, Slovakia, and Austria.

At this stage of the Preparatory Phase, the costs of construction take into account the amount of money invested by the Member States to upgrade existing or to build new BSL-4 laboratories with the perspective of the implementation of ERINHA. The information on this issue is, at present, being collected, as no detailed costing or budget projection is available. In the operational phase of ERINHA, the costs will mainly concern the money needed for running the ERINHA central coordinating unit and to invest into new equipment and technologies to be installed in BSL-4 areas. The operation costs are still under estimation since the composition of the central coordinating unit is not finalised and the technological gaps are under analysis. There is no detailed cost estimate and budget projection currently available. From the money that comes from the users, 80 % will pay for the use of the facility, while 20 % will be held for investing in new facilities. The idea is to collect money to build up a fund.

With regard to financial commitments, a meeting to define the stakeholders, with all Member State representatives has been held. At present, however, only expressions of interest have been declared. This seems to be in part due to the lack of cost and financial plan at this stage, but information is expected to be available in summer 2014.

As far as governance and legal management is concerned, the dominant concern is the national partners' insistence on preserving national autonomy. The management stated that by the beginning of 2013 they were hoping to reach a final agreement and a final detailed consensus on the issue of the relationship between the national nodes and the overarching European research infrastructure structure. At present, the partners are looking into legal options, comparing them and weighing pros and cons. The move to an ERIC is not ready, and has not been decided on by all involved. Regarding governance, the most important problem is achieving the balance between partners and the overarching decision-making structures. These issues create doubts whether ERINHA really is an infrastructure or just a collaboration.

During the interview it was stated that there is now a shared vision of having a central coordination unit plus guaranteed open access to national facilities (respecting national autonomy). Arguments for a research infrastructure are not convincing at this stage and need further elaboration. As things stand at the moment, the mission could be accomplished by a network unless a strong relationship between the nodes and the foreseen central investment programme is achieved. A concept paper is under preparation in order to convince partners and governments.

As far as user strategy is concerned, the existence of a proposition for the data access policy is not defined and there is no report on work in progress. There is interest from industry to use the facility, mainly SMEs. It is not yet clear how they will be involved.

There is no risk report. Risks are mentioned only marginally in the Questionnaire and refer only to the participation of other institutes and lack of cash funding.

Recommendations

- Since there are investments planned (20 % of the income), a reasonable scientific plan should be developed in order to identify the possible and required investments and the required budget. EUR 2 million per year will be needed just to run ERINHA. In addition to the research performed as a result of peer-reviewed access from external proposals, some joint research activities could plant seeds for more collaboration and a more enthusiastic European vision among the partners.
- The case for a research infrastructure instead of a networking and access programme should be made more convincingly. A convincing added-value statement should be developed together with strategic and implementation plans, also as important tools to convince other institutional and governmental partners to join ERINHA.
- The Director should be given wider powers in order for him/her to function efficiently. So far this has not been accepted by the partners because of the stated concern for national autonomy. Extra effort should be made in order to resolve, at least to a certain extent, the balance between national autonomy and the need to coordinate activities.
- A joint Scientific and Ethical Committee is planned. Considering the delicacy of the business at hand it would be advisable to separate the scientific from the ethical.
- ERINHA should initiate discussions with other biomedical research infrastructures on collaboration and synergy, and should therefore take advantage of the EC-funded cluster project BioMedBridges for biomedical projects.
- All relevant points for user strategy have to be developed and are yet to be defined since the user community is not yet mobilised. A more active identification and engagement of scientific communities and an assessment of their needs should be made a priority, especially as this community has special requirements.
- As ERINHA is an infrastructure on highly pathogenic agents, security issues should be dealt with seriously. A Risk Report taking into account at least the major risks would be highly recommended.
- Once a mission statement, strategic and implementation plans, user-access model and KPIs are developed, it is strongly recommended that they be independently evaluated. An independent scientific and technical review and an independent project cost review, also taking also into account risks, seem essential to reach an Investment Decision. A positive result of such reviews would show that a project Implementation Phase could be successful in cost, schedule and performance.

Conclusions

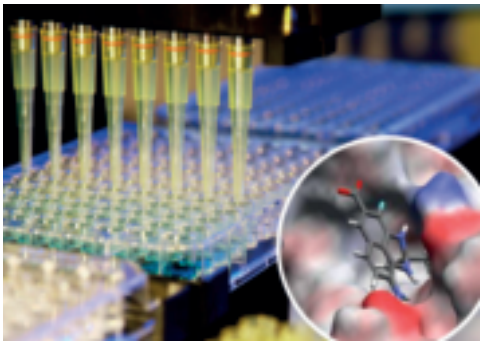
Although ERINHA has officially been on the Roadmap since 2008, the project is still at a very early stage of definition, in which finance, governance, user strategies, stakeholder engagement, risk assessment etc., and last but not least, the relationship between national partners and overreaching European research infrastructure, have yet to be developed and crucial decisions are yet to be made.

As such ERINHA is not considered to be mature at this time. The consortium constitutes a network of strong national facilities and although they could have developed a convincing joint work plan, governance and project organisation to become a truly integrated research infrastructure, so far they have not done so.

The AEG' opinion is that there is insufficient commitment to do this and that the chances of achieving implementation by 2015 are minimal.

EU-OPENSCREEN — European Infrastructure of Open Screening Platforms for Chemical Biology

Key issues and findings



High-throughput screening to discover biologically active substances. © Leibniz-Institut fuer Molekulare Pharmakologie (FMP)

EU-OPENSCREEN has been on the ESFRI Roadmap since 2008. The project is expected to develop novel research tools for all fields of the Life Sciences (including molecular, cell, plant, structural and micro-biology; synthetic and medicinal chemistry; pharmacology and early drug discovery, etc.).

The research infrastructure is mostly a networking effort with a Central Compound Collection Management Facility (CCMF) in Berlin and a European Chemical Biology Database (ECBD) at EMBL-EBI in Hinxton (UK), which also manages the BioMedBridges umbrella project, but with a critical, novel funding agency-type aspect. The management intend to fund 30 to 200 projects per year. Construction costs are given as EUR 25 million, with EUR 1.8-2.0 million per year for the operating costs of the research infrastructure and EUR 12-43 million per year for 50-200 projects. A minimum of 30 are to be funded by the ERIC members and the rest from EU funds and national sources.

An ERIC encompassing the central office, services, a database and the compound collection is proposed. The research infrastructure will be built on a distributed network of screening facilities with five to eight high-capacity screening sites, 10-20 specialised screening sites and chemistry sites. The central office is to provide a single point of access to the network, manage project submissions and perform financial control. Service agreements are foreseen for the relationship between the ERIC and the national nodes. Currently partners of the Preparatory Phase include institutions from Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Italy, Norway, Poland, Netherlands, Spain, Sweden and Romania. New countries must first build a national network. The central budget of the ERIC includes EUR 10 million core investment.

No financial commitments from Member States or other possible shareholders are available yet. The finance calculations have been made on the basis of previous experience and the confidence of the figures is not specified. National investments in the participating institutions are deemed essential. The management maintains that EU-OPENSCREEN's service partners are embedded in their host universities or research institutes, which constantly invest in these platforms to offer their scientists state-of-the-art technologies, so that EU-OPENSCREEN can use these resources and assure that it offers the most advanced technologies to its users. However, the management will not control either the national partners or the national funding agencies.

Statutes are reportedly under internal review, an Ethical Body is planned in the ERIC governance.

As a research infrastructure, EU-OPENSCREEN it is still at an early stage of organisation. Major milestones during the Preparatory Phase are the agreement on the future layout of the research infrastructure — including site selection expected in April 2013 — the preparation of a Business Plan and of MoUs. The Business Plan will be finalised in first quarter of 2013 to substantiate EU-OPENSCREEN's negotiations with ministries of Member States. In other words, ERIC statutes, business plan, MoUs, model of interaction with industry, etc. are all still being iterated. KPIs are given in terms of the number of projects selected and the number of compounds synthesised. However, the size and significance of the projects and the importance of the compounds being synthesised do not enter the formulation of the KPIs.

The idea of centrally funding projects submitted as a result of open calls for proposals by researchers from partner institutions, from the research community at large and from the industrial community has many institutional, organisational, technical and legal aspects that do not seem to have been sufficiently addressed. Firstly, national funding agencies might be unwilling or unable to accept EU-OPENSCREEN to partially replace them in using national contributions to fund national research groups. Secondly, peer-reviewing and monitoring projects submitted by partners and non-partners alike, is a complex task that may leave the organisation open to conflict-of-interest charges. Thirdly, funding specific projects, also of an industrial character, may carry financial, technical, ethical and intellectual property-related responsibilities and risks that should be carefully evaluated *vis-à-vis* the organisational structure envisioned. The only hint of specific project organisation in this area seems to be the proposed appointment of 'project moderators' reporting directly to the Director-General.

Apart from general statements about open access, there seems to be little clarity about the composition and size of the prospective user community and of the expected participation of industrial users.

The project management state that there are no major technical risks. This seems an extremely optimistic statement, because building up any technical system — even a copy of an existing one — or a simple upgrade carries a technical risk.

Recommendations

- The negotiating process for governmental commitments is expected to start in the first quarter of 2013. Organising fundraising needs to be a work-package for defining an appropriate stakeholder's strategy in its own right. A strategic plan for this should be developed with high priority, including identifying the appropriate government contacts and the leadership of this process.
- Because national investment in the participating institutions is deemed essential, the project should consider developing strategies to monitor and, if necessary influence, such investments, perhaps utilising the bilateral cooperation contract binding partner sites to the ERIC, including specifying the influencing of upgrade investments and/or establishing some type of EU-OPENSCREEN certification. A Delivery and Investment Strategy should be developed.
- Further investigation is required regarding the institutional, organisational, technical and legal implications of centrally funding projects submitted as a result of open calls for proposals.
- One of the most important tasks of the Preparatory Phase should be to clarify the composition and size of the prospective user community and, in particular, the role and engagement of industry.

- The risk analysis should address organisational, scheduling and technical risks. International contracts, the achievement of consensus on financial shares and the nomination of board members are needed. The situation with building permits on existing sites may cause unexpected delays. In view of the aimed at 'moderate open access' (see document D8.4), related technical risks should not be ignored, such as how to deal with harmful assays and data protection.
- Since the results of a project might be extremely interesting from the pharmacological-commercial aspect, even during the hold-time of project data access excellent data protection should be in place.
- Once a business plan, MoUs and KPIs for the research infrastructure as a whole and for the service partners are available, it is recommended that they be independently (externally) evaluated. A thorough review of the final organisational, technical and financial aspects, including a risk analysis will be essential before an investment decision is taken.

Conclusions

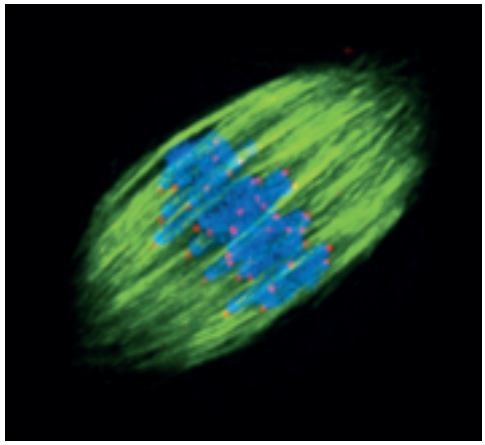
As a research infrastructure, EU-OPENSCREEN is still at an early stage of organisation. MoUs have to be signed, the draft statutes currently under internal review will have to be carefully assessed at a later date, and all governance structures will have to be assessed once again and checked for progress. Several critical aspects should be investigated in depth during the Preparatory Phase. Once sufficiently developed, the project will need a new independent evaluation.

EU-OPENSCREEN has clearly not yet reached maturity and the chances of achieving readiness for implementation by 2015 are considered minimal at this point.

Euro-BioImaging — Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences

Key issues and findings

Euro-BioImaging is a distributed research infrastructure aimed at providing open access to the full range of cutting-edge imaging technologies enabling world-class life science research. It has been on the ESFRI Roadmap since 2008 and is in the second year of the Preparatory Phase. At present 22 countries (Austria, Belgium, Czech Republic, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Israel, Italy, Luxemburg, Netherlands, Norway, Poland, Portugal, Sweden, Switzerland, Spain and the UK) are engaged in Euro-BioImaging.



Mitotic cell with chromosomes in blue and spindle in green
© EMBL Heidelberg

The research infrastructure is organised in a hub and national node structure. Details were provided on the planned organisation of node construction and operation cost, as well as on the levels of existing and planned investment in imaging infrastructure in Member States. Both the node upgrade at a cost of EUR 395.25 million in 2014-2018 and EUR 30.17 million per year operating costs are kept within the scope of the project. The management expects, however, that procurement of imaging instrumentation will be conducted at the node level. In most cases instrumentation will be commercially available from bio-imaging suppliers.

Very top-level costs and a funding model were provided for the hub (EUR 13.8 million over five years) and the estimated operation costs for the hub and for node access (EUR 140 million over five years). The typical investment cost for a piece of equipment for the upgrade of a node will be around EUR 15 million. The funding model will be based on membership fees. There are plans to channel transnational access funds via the hub, this will also be the case for the access costs which will be funded from membership fees.

The governance structure is in an early state of preparation, different models are being examined but no firm agreements were reached at the meeting of the Steering Committee in January 2013. The main concern is the relationship between the nodes and the hub.

Service to transnational users will be used to gauge the quality of the nodes. Euro-BioImaging will monitor user satisfaction (papers, proposals submitted, etc.) to gauge success. Based on such parameters, the project wants to award 'high-quality' badges to well performing Euro-BioImaging nodes and propose changes for the less performing nodes.

Euro-BioImaging presented a table of major investments already made (EUR 438 million) and planned (EUR 354 million). What is not clear is to what extent these investments are the result of or substantially influenced by Euro-BioImaging. Service level agreements with nodes and periodic reviews are planned and they will be essential for future quality control. Euro-BioImaging presented a well-developed plan for engagement

of funding stakeholders, which contains a major commitment from industry. The organisation of the WP4 funders table with high-level representatives of the funding agencies is an important initiative.

A thorough and very valuable analysis of the potential user community was conducted during the Preparatory Phase. A detailed access policy has been drafted, which addresses ethical issues. Euro-BioImaging will have peer-reviewed open access and the consortium has assembled an Industry Board to handle the connections to industry. The management states that there is good contact between Euro-BioImaging and the other biomedical research infrastructures initially through the BioMedBridges project.

A good listing of risks has been provided in setting up the infrastructure, likelihood assessed, mitigations strategies discussed.

Recommendations

- Negotiations on the governance and legal structure with all involved partners should be initiated as soon as possible considering the complexity of the negotiations and the limited time available to reach an agreement before the end of the Preparatory Phase. Concerns about autonomy need to be negotiated and a consensus reached if Euro-BioImaging is to get the structure in place by the end of 2013. To accomplish this it may be necessary simplify some of the divisions in governance.
- The position of the Executive Director should be reconsidered in order to provide him/her with executive power.
- The position of the Ethics Advisory Committee should be defined precisely.
- Some of the divisions of labour and responsibility in the governance should be simplified, especially the division between the Science Advisory Board in governance, while the Ethics Board is in the advisory structure.
- The call for nodes with a strict review process is commended. This will allow Euro-BioImaging to exercise control over relevance and quality of the nodes, even in the absence of influence over the original investment decisions.
- A contribution model based on GDP-related (Gross-Domestic Product) membership fees should be considered.
- The project has set some severe deadlines for the milestones (e.g. September 2013 Final Euro-BioImaging Business Plan published; October 2013 Decision on constructing the first set of nodes). The deadlines appear very ambitious and should be re-evaluated.
- Convergence on the legal structure to be adopted seems urgent. Progress should then be carefully monitored to make sure deadlines are met.
- The proposed parameters to monitor user satisfaction (papers, proposals submitted, etc.) are reasonable, but target values should be identified in order to obtain KPIs to gauge success. The idea of awarding 'high-quality' badges to well performing Euro-BioImaging nodes and propose changes for the less performing nodes seems good, but it may be difficult to implement. Therefore it is strongly recommended that these measures for success be clearly spelled out in the by-laws of the Euro-BioImaging legal entity and any future collaboration agreements. A quality control like ISO9000 could be envisaged.
- Because both the node upgrade at a cost of EUR 395.25 million in 2014-2018 and EUR 30.17 million per year operating costs are kept within the scope of the project, appropriate strategic and implementation plans to coordinate all this should be developed and measures to minimise the cost increase that may derive from node-by-node procurement put in place. Methods to control costs by negotiating procurement

should be envisioned and embedded in the by-laws of the legal entity and in any future collaboration agreements.

- The collaborations with other biomedical research infrastructure projects should be further developed.
- The future risk list should include an analysis of ICT risks, in particular as cloud computing is foreseen.
- An independent scientific and technical review and an independent project cost review, taking also into account risks, seem essential. A positive result of such reviews would show that a project implementation phase could be successful in cost, schedule and performance.
- The procurement of imaging instrumentation will be conducted at the node level; in most cases the instrumentation will be commercially available. Methods to control costs by negotiating with national nodes to have common procurement strategies should be envisioned and embedded in the by-laws of the legal entity and in any future collaboration agreements.

Conclusions

Euro-BioImaging is a distributed research infrastructure that has been on the ESFRI Roadmap since 2008 and is in the second year of the Preparatory Phase. Euro-BioImaging is supported by a large number of Member States and good progress has been made during the Preparatory Phase to define the governance, legal and cost structure of the project.

However, several important unresolved issues remain, and in the AEG's view the chances of achieving implementation by 2015 are considered to be minimal.

INFRAFRONTIER — European Infrastructure for Phenotyping and Archiving Model Mammalian Genomes

Key issues and findings

Archiving and distribution of Mouse Models in INFRAFRONTIER. © Bernd Müller

INFRAFRONTIER has been on the ESFRI Roadmap since 2006. It is mostly a networking and standardisation effort between pre-existing national research infrastructures stemming from an equally named I3 transnational access programme with the addition of a EUR 625–850 thousand per year GmbH legal entity, an I3-derived Efficient Mixed-Model Association (EMMA) Repository Unit, which is already fully operational, and a phenotyping business unit, which the managers expect to start operations soon. The research infrastructure includes in its scope both the centre and the national research infrastructures with stated EUR 180 million construction costs and EUR 80 million per year operating costs to meet the demand for systemic phenotyping, archiving and distribution of mouse models.

Criteria to claim national investments within the scope of the project are based on the process for accepting centres that requires a letter from the ministry designating the centre as the national centre, support letters from the national research community and a site visit from INFRAFRONTIER to check the quality against common standards. The driver for the creation of a research infrastructure is said to be visibility, being able to switch from project funding sources to institutional funding and introducing quality assessment.

The founding members (Helmholtz Zentrum München, CNRS France, University of Oulu Finland, BSRC Alexander Fleming in Greece and the EMBL) are expected to provide the initial GmbH operating funds. There will be bilateral contracts between the GmbH and the national centres. The annual budget of the INFRAFRONTIER legal entity will be adjusted to the number of shareholders. This also takes into account that the operations of the legal entity will scale with the number of partners. Staffing at the legal entity is foreseen at 7.7 FTEs for full operations. There is a good understanding of cost breakdown of the central activities. The project managers feel that more money in the central hub would not help much in achieving better results, though they could use more resources in building capacity and for risk management.

National investments seem to be in place. The central budget for 2013 is committed, but long-term commitments to the central infrastructure and to national centres still need to be secured. The role of industry is not fully addressed.

There is already a wide existing scientific user community worldwide for mouse models. The user statistics that were provided are based on the use of EMMA without, as yet, the

inclusion of the national nodes. A unified access portal is planned but not yet available on the website. User related KPIs are listed but have not been analysed.

The contacts with the industrial users are at present through the national nodes. No common rules have been formulated so far.

Discussions are underway with BBMRI and ELIXIR, hoping to establish a meta-database.

The documentation provided contains a risk assessment tailored to the research infrastructure. Technological and market risks are discussed. Data-protection risks seem not to be critical here. Managerial risks are discussed. Animal protection is always an issue, and in the interview it was explained that the legal framework for animal protection is very strong and respected in every regard.

Recommendations

- Because it is the coordination role of the GmbH that will make the overall research infrastructure function, a plan to gradually increase the range of services and revenues, even in the absence of Horizon 2020 funding, should be developed, involving as much as possible the national nodes from the start to avoid the risk that the centres/Member States may see stronger coordinations as a threat. This should start from a gap analysis and an inventory of existing capacity, showing the value-addition of a European infrastructure.
- Because investments and efforts at the national centres are kept within the scope of the project, a more structured approach to organise procurement and recruitment in order to maximise the project impact, while minimising costs, should be considered. The 'very strict' procedure for 'accepting centres' could be a good starting point. An international procurement coordination task force might be envisioned to contain costs if the quoted EUR 180 million procurement is handled centre-by-centre.
- To strengthen the research infrastructure as an integrated structure, it is recommended to strengthen the coordinating role of the GmbH/ERIC, especially since INFRAFRONTIER aims to have a strict selection process for accepting national nodes.
- Despite commitments to invest from some major countries, legal documents have not been signed. Therefore organisation of the long-term funding of the operations should be treated as a work-package of some complexity.
- Whilst starting as a GmbH, INFRAFRONTIER aims for an ERIC 'whenever feasible'. The legal documents for a GmbH can be converted to an ERIC without much change. Statutes should be kept as flexible as possible, so that if an ERIC cannot be achieved, INFRAFRONTIER could, up to a certain point, flexibly reposition itself. Alternative business models might be examined to guarantee long-term sustainability.
- The research infrastructure management claims that there is no distinction between non-commercial and commercial users, since any licensing agreements and potential additional licensing fees are handled directly by the national partners or by the providers of the mouse material. But the national research infrastructures are within the scope of the project and the business model of a company (GmbH) without paying clients is very different from that of the competition, e.g. the JAX institute in the USA which grossed USD 144.4 million from paying clients in 2011. Alternative business models should be examined to guarantee long-term sustainability.
- In the one to five year period an Ethical Board will need to be established, not just because of animal welfare, but because of possible wider ethical issues. It is not sufficient that each centre has an ethical committee; there should be one at a higher level.

- The Science Advisory Board needs to be clearly defined and procedures for nominations and the election of members should be transparent, especially because of the nature of the work.
- Clear common guidelines for industrial access should be established.

Conclusions

INFRAFRONTIER has been on the ESFRI Roadmap since 2006. It builds on a considerable investment in various European countries and in EMBL in facilities for mouse models. Currently INFRAFRONTIER is more a networking effort than an integrated research infrastructure. The legal documents are not yet signed, but INFRAFRONTIER assumes that at least five countries and EMBL will join the legal entity and pay the 2013 contribution. For the legal structure an ERIC is targeted. Until that is realised, a GmbH is foreseen (to be established in 2013).

Currently INFRAFRONTIER cannot be considered mature (signed statutes, stable governance and commitments for the various research infrastructure phases in place), but if the AEG's recommendations are implemented this could be achieved by 2015.

INSTRUCT — Integrated Structural Biology Infrastructure

Key issues and findings

CERM NMR laboratory

INSTRUCT is a distributed infrastructure that aims to provide the European research community with access to a large catalogue of equipment and expertise in technologies that support structural and cell biology. INSTRUCT has been on the ESFRI Roadmap since 2006. INSTRUCT originates from previous EU-funded projects: SPINE and SPINE2. The EC funded Preparatory Phase has just finished. The management envision a two-year transition period to the implementation phase. Current INSTRUCT membership includes Belgium, Czech Republic, France, Germany, Israel, Italy, Netherlands, Portugal and the United Kingdom. The project management states that advanced negotiations for membership currently involve Austria, Estonia, Finland, Spain and Sweden. The national membership fee (EUR 50 000 per year) will allow scientists from the country to apply for access to INSTRUCT's infrastructures. It is mostly a networking and transnational access effort between pre-existing national research infrastructures with close links to the I3 access projects for structural biology BioNMR and BioStructX.

The research infrastructure management includes investment in the national nodes within the scope of the project and quote a EUR 231.8 million investment cost over five years, i.e. to 2016. These are independent bottom-up efforts funded by the national nodes and without evidence of central INSTRUCT influence. For the activities supported by the subscription fees from the national members a very detailed and well-prepared cost breakdown was provided. These are expected to cover the cost of the central hub/coordination centre in Oxford, coordination activities, training activities and R & D for pilot projects and some minor access costs. The EU I3 access programme currently supports user access to some of the central facilities. INSTRUCT foresees a substantial financial uplift from 2015 primarily funded through access charges, until then the plans are to maintain the present financial level.

The present governance structure is a combination of an International Collaboration Agreement and a not-for-profit entity (Instruct Academic Services Limited). Reportedly, the current 15 centres of INSTRUCT have been selected during the Preparatory Phase based on an evaluation of the technological need and scientific excellence. With INSTRUCT in full operation it is the intention to use the coming two years to review and decide on a new governance structure, which could be an ERIC.

Two calls for proposals have been planned (Research and Development Awards) for applications requiring access to INSTRUCT infrastructure (technology and expertise), with a particular focus on integrated structural biology. The first call (published on 8 October 2012) received 70 applications, of which 10 were approved and funded up to EUR 10 000 each. Such calls for proposals are intended to stimulate the technical development of the project. However, investments in the new and improved equipment

and provision of staff appear to be the result of a bottom-up process financed from different, primarily national, sources.

Measurable KPIs for the project as a whole do not exist.

The user community, comprising structural and cell biologists, is reported by the management to be around 10 000. Users in general use more than one of INSTRUCT's technologies and INSTRUCT states that the single INSTRUCT access point makes it easy for the users to obtain access to all the technologies of INSTRUCT. For academic users INSTRUCT aims at providing peer-reviewed access free of charge and requires only coverage of consumables. This is currently possible as many of the INSTRUCT centres are involved in the I3 access projects. Non-academic users can access the infrastructure in the same way as academic users but have to cover all costs associated with the use of the infrastructure. The contact with industry is ensured by an Industrial Working Group. INSTRUCT runs an extensive training programme focusing on integrative techniques. The management reported that INSTRUCT has contacts and collaboration with several other biomedical research infrastructures.

The risk analysis provided shows that the management are aware of the problems of general management risks. However there is no mention of technical risks (failing of equipment), legal consequences of mistakes and IPR infringements are not addressed, data protection for possible commercial use has not yet been considered, at least not as a risk.

Recommendations

- Currently, INSTRUCT's planned investments in the new and improved equipment and provision of staff appear to be a result of a bottom-up process financed from different, but primarily national, sources. It would be valuable to develop an overall INSTRUCT Investment Strategy that should be subjected to an independent external evaluation. The independent audit of the INSTRUCT infrastructure that the management intends to conduct in 2013-2015 could be the basis to construct a roadmap for investment in structural biology infrastructure across Europe and influence national decisions in this area.
- The present stakeholders are a mix of research institutes and government agencies. A structured plan for addressing the Engagement Strategy of funders is necessary. It is recommended that the long-term funding of the INSTRUCT central facility be made a project in its own right led by experienced science policy-makers.
- A risk analysis should be developed for the ERIC option if this will imply that certain institutions are not able to join.
- The governance structure should include an Ethical Committee.
- Measurable KPIs for the research infrastructure as a whole do not exist. They should be developed as soon as possible, and used in an independent evaluation of the research infrastructure.
- Methods should be devised to influence the procurement and staffing decisions of the national centres leading to a credible budget control system, as there is no formal mechanism for aligning investment across Europe. This is a necessity if the national efforts are to be kept within the scope of the INSTRUCT project.
- Creation of an improved risk catalogue once the infrastructure is more advanced is recommended.
- Complementarity and cooperation with other related biological research infrastructures like EUROBIOIMAGING and ISBE should be explored.

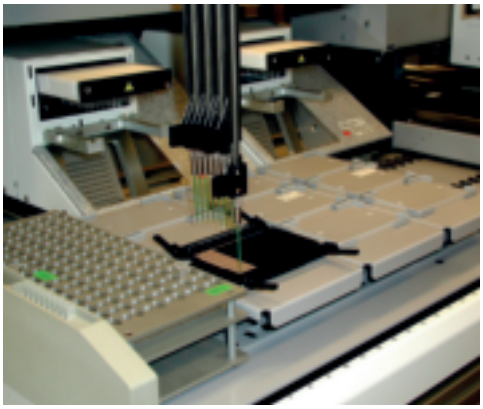
Conclusions

INSTRUCT has been on the ESFRI Roadmap since 2006. At present nine countries have signed up as national members with an annual fee of EUR 50 000. The investment in instrumentation relies on the national nodes. INSTRUCT is mainly a networking and transnational access effort with links to I3 access projects. To reach full maturity INSTRUCT should develop an Investments Strategy in structural biology infrastructure in Europe that should be subjected to an independent external evaluation and subsequently used to coordinate national developments within INSTRUCT.

Substantial efforts will be required to have this in place by 2015. However, if this is done and if the other AEG recommendations are successfully addressed, then implementation by 2015 could be achieved.

ISBE — Infrastructure for Systems Biology — Europe

Key issues and findings



A TECAN Genesis 2000 robot prepares Ciphergen SELDI-TOF protein chips for proteomic pattern analysis
© National Cancer Institute

ISBE has been on the ESFRI Roadmap since 2010. The EC funded Preparatory Phase (EUR 4.7 million plus in-kind contributions from participating institutes) started in August 2012. The UK (Imperial College London) is the coordinator with Czech Republic, Germany, Greece, Spain, Finland, Ireland, Netherlands, Norway, Sweden and Slovenia as partners. ISBE aims for an interdisciplinary approach to the study of biological complexity in health and disease, biotechnology (including energy) and environmental science. One of the Preparatory Phase work-packages will be defining the principles and 'ethos' of systems biology that overarch the following areas of application: systems medicine, systems immunology, systems ecology, systems microbiology, industrial systems biology, evolutionary systems biology, structural systems biology, environmental systems biology, systems biology of development, systems biology of ageing, systems biology of pain, etc. and defining where systems biology needs to be in five and ten years from now.

ISBE will be a distributed, interconnected infrastructure that will comprise three types of centre: Data Integration Centres (DICs), systems biology dedicated Data Generation Centres (DGCs) and Data Stewardship Centres (DSCs). Project organisation, work breakdown structure, deliverables, etc. are only available for the Preparatory Phase. The projected (but not committed) investment cost estimate of EUR 300 million, to be spent between 2015 and 2018, and annual operating cost of EUR 100 million, are primarily for desired investment and support in the national nodes. The budget at the central level has not yet been defined.

ISBE is between a networking and access programme and a distributed research infrastructure. It includes very substantial research elements, thus stretching the research infrastructure concept beyond the boundaries even of a distributed facility. ISBE has the ambition to be a data infrastructure plus modelling and high throughput analysis, with skills development as well as coordinated research. ISBE aims to introduce a culture change in biology towards big science approaches.

In terms of the financial model for funding the core activity, ISBE is looking at ELIXIR and other research infrastructures as potential models.

At the moment, they have a very large Steering Committee, but according to their statements this is not a problem and their Director meets regularly with the work-package leaders.

The research infrastructure being in a very early stage, any assessment will require the development of an activity plan with suitable deliverables and project-wide KPIs. Such documentation will also be needed to present a reasonable and convincing offer to pro-

spective funders. It is not clear how industry is going to be involved. A broad range of stakeholders is identified, but it is not evident how the engagement will be organised, as neither a User nor a Stakeholder Engagement Strategy have been developed as yet. User-related aspects will be dealt with in several of the work packages.

It cannot be said to what extent research funding agencies, apart from NWO, BBSRC and BMBF, are committed. Based on the available information, it cannot be assessed whether the research infrastructure is sufficiently embedded in the institutes concerned or whether it is mainly carried by individuals. The Business Plan for the funding, part of the Preparatory Phase deliverables in WP11, is going to be an essential document for further assessments.

Relationships with other ESFRI research infrastructures in the form of collaboration agreements are mentioned, in particular with ELIXIR and INSTRUCT.

There is a good list of risks for the Preparatory Phase, mostly dealing with organisational, legal and funding risks. A risk register for the research infrastructure as a whole will be developed.

Recommendations

- There is a need to consider whether this is a distributed research infrastructure or a network. Convincing arguments for a research infrastructure must be developed during the Preparatory Phase. A solid Business Case and Delivery Strategy should be produced, on the basis of a gap analysis.
- Funders other than BBSRC, NWO and BMBF need to be engaged at an early stage and should be involved in developing the research infrastructure. This could be organised through a high-level Intergovernmental Working Group.
- ISBE should focus as soon as possible, and decide on, the legal structure because negotiations take time.
- The project management plans to keep the national nodes as part of the project and take responsibility for their activities and development. This seems an ambitious goal and negotiations with prospective stakeholders should start as soon as possible during the Preparatory Phase to ensure this.
- An overarching Ethical Board should be envisaged, and not only at national level. This is important because it, among other things, puts emphasis on the notion of an integrated research infrastructure.
- Transparent and clear procedures for the nomination and election of Science Advisory Board members should be included in future documents.
- Once an activity plan, business plan, schedule, milestones, user-access model and KPIs are developed, it is strongly recommended that they be externally evaluated. Such an independent scientific and technical review and an independent project cost review, also taking into account risks, seem essential to reach an Investment Decision. The extremely ambitious goals require a carefully designed path, with involvement of the funders and the scientific community. ISBE should invest in the management of this complex process.
- If industry is seen as a demand-pull partner, then their involvement should be organised via an Industrial Advisory Board.
- Engaging the scientific stakeholders means bringing about a culture change in the biological science community towards accepting systems biology as a scientifically viable big science approach. If ISBE sees its mission to achieve this culture change, much more effort is necessary than the current Preparatory Phase work package.

- ISBE should not do what ELIXIR is aiming to do. ISBE and INSTRUCT have challenges in common which they could address jointly. There are relationships with BBMRI. All of these relationships should be clarified during the Preparatory Phase.
- During the Preparatory Phase procedures for user access and data handling should be defined.

Conclusions

ISBE is an ambitious initiative to introduce a culture change in systems biology towards a big science approach. ISBE is early in the Preparatory Phase, which is scheduled to be completed in 2015. Discussions on the legal status and governance have not yet started. There is no financial commitment beyond the Preparatory Phase. Today the project is thus clearly not mature. Implementation of the AEG recommendations and in particular the development of a business plan for a staged approach to the research infrastructure are essential preconditions for achieving maturity and should be used as a basis for negotiations with (scientific, industrial and governmental) stakeholders.

However, the chances of achieving implementation by 2015 are judged to be minimal at this point.

MIRRI — Microbial Resource Research Infrastructure

Key issues and findings

MIRRI is a distributed research infrastructure that will be providing microbiological services, facilitating access to microorganisms and associated data. It has been on the ESFRI Roadmap since 2010. The research infrastructure started its Preparatory Phase in November 2012; therefore only part of the questionnaire of the AEG could be answered. At the time of the interview it was still unclear whether MIRRI would just manage access to collections, or play a strategic role in influencing or even funding further development of the infrastructure. The main issue in any case is the upgrade of microbiological strain storage capacity.

At present there are few details of costs or commitments beyond the Preparatory Phase. There are some top-level cost estimates of the main elements from a previous study, but no agreed financial model. They need to redefine costs and are just starting to think about numbers. Each collection has very different funding and access models. There has been some contact and interest from potential funders. There is still no gap analysis on where it is foreseen to spend EUR 190 million, though work is underway on this.

The legal structure is not defined yet, and the governance structure is rudimentary at this stage. An ERIC is under discussion, and they are debating how to progress. Relations with EU-OPENSCREEN, BBMRI, EMBRC and others are quoted but the nature of the relationships remained unclear even after the interview.

The consortium needs to decide what percentage of the national activities should be brought within the scope of the research infrastructure. KPIs are being developed.

The identities of the key stakeholders are is not clear at this point; negotiations are under way.

The number of potential users is also unclear. Bio-industry federations have been approached without much success, although there are lots of relationships with small and medium enterprises. They are working on their user community needs, because 80 % of their collections are not accessed. Presently the ratio of academia to industry users is 60/40.

There is a well-prepared risk list, though bio-security is not covered.

Recommendations

- The vision and scope of the project still needs to be defined; A Feasibility Study providing the evidence of the needs for an infrastructure to coordinate access to microbiological materials, their associated information and services would be very helpful in this regard.
- The work on the vision should be completed as soon as possible so that activities can start on the financial model and financial planning to support this vision.
- It is recommended that, although at a very early stage, the management start thinking about developing a governance structure. It has been found in other research infrastructures that the leadership is focused on other issues and they leave governance until quite late in the project, while the negotiation process may take a long time.
- MIRRI needs to redefine costs. A financial plan needs to be developed, because each collection has very different funding and access models.
- In the negotiation and in the conceptualising of future governance, special attention should be paid to how the nodes will interact with the higher levels of the infrastructures. If MIRRI wishes to become an integrated research infrastructure, it is important that the central hub has a strong role in relation to the national nodes. This role should be specified in service level agreements.
- An ethical body should be envisaged for the future because it is not enough to rely on national regulations at the various hubs.
- The Preparatory Phase will firstly need to define a reasonable scope for the project so that a strategic plan and an implementation plan can be developed. Any assessment will require the development of an activity plan with suitable deliverables and project-wide KPIs. Such documentation will also be needed to present a reasonable and convincing offer to prospective funders.
- Once an activity plan, business plan, user-access model and KPIs are developed, it is strongly recommended that they be independently evaluated. An independent scientific and technical review and an independent project cost review, taking also into account risks, seem essential to reach an investment decision. A positive result of such reviews is essential to show that a project implementation phase could be successful in cost, schedule and performance.
- A clear picture of the potential user community should be obtained.
- A plan to engage with governmental stakeholders is recommended. It is advisable to build on potential interest from funding bodies at an early stage and think about building them into governance structure. Engagement should not only be with the funders of the collections, but also with research funding agencies. Setting up an intergovernmental working group with high-level representatives should be considered.
- Activities to define and attract potential new users should be undertaken with high priority, this would also increase the access rate to the collections. As end users generally need information from the collection in combination with information or research from other institutes, MIRRI should identify which ones and engage with them.
- Biosecurity and biosafety are mentioned in the work-programme, but not in the risk list, it would be advisable include them.
- MIRRI identifies relationships with BBMRI, EMBRC, EU-OPENSCREEN and ERINHA. These relationships should be explored and defined in partnership agreements. In addition it would be worthwhile discussing more in depth if and where MIRRI could play an important role in ISBE, the Systems Biology Europe infrastructure. It was the impression of the AEG that such a connection could be advantageous for both ISBE and MIRRI: for ISBE since microbiological collections are one of the pillars needed by experimental systems biology, for MIRRI because the extension of the collections could get a more systematic input and a likely significantly higher use rate.

Conclusions

MIRRI has only just entered the Preparatory Phase and is not mature at this point in time. The recommendations show many important issues to be resolved before the infrastructure can reach the implementation phase, but also opportunities worth exploring since MIRRI has the potential to become an important pillar for other research infrastructures that are active in the microbiological and systems biology fields.

MIRRI is at a very early stage with much to do. Additionally proposals for strong relationships to other research infrastructures could have organisational consequences that need to be addressed. In view of this the AEG consider that the chances that MIRRI will be ready for implementation by 2015 are minimal at this point.

3.5 Materials and Analytical Facilities

EMFL — European Magnetic Field Laboratory

Key issues and findings

The EMFL develops and operates world class high magnetic field facilities, to use them for excellent research by in-house and external users.

EMFL has been on the ESFRI Roadmap since 2008. The aim is to create a distributed European Magnetic Field Laboratory including HFML (RU/FOM), LNCMI-G&T (CNRS) and HLD (HZDR). The EC funded Preparatory Phase will run from the beginning of 2011 until the end of 2013. The goal of the Preparatory Phase of the project is to investigate all legal, financial, organisational and employment related issues, and to formulate a document for the founding agreement of the EMFL between the three partners and any other stakeholders that might be identified, although many decisions and the related documentation are still to be agreed.

The EMFL founding partners have access to high magnetic field facilities, which reportedly represent a construction value of EUR 120 million. The operation costs of the facilities are EUR 22 million per year for full operation and an additional EUR 8 million per year is needed.

The financial model is based solely on national investments in national facilities that will be considered part of the European research infrastructure. Access will be granted via a selection committee with selection based on scientific excellence with no regard to where the researchers come from. It was not clear if funding will be via in-kind contributions or membership fees. A clear funding model for the coordinating activity is not available. The role of research funding agencies (other than NWO/FOM) is not defined. Contact with governments and funding agencies is generally via users, but a strategic stakeholder's policy does not exist. Reliance is placed on high profile users lobbying the funders. This model generally presents a high risk of not being effective.

Most elements of the governance, including the legal structure, have yet to be developed. The currently proposed legal structure is an AISBL, the founding documents and statutes for which are in preparation. An ERIC is also under consideration. It is not yet decided if the core staff will be employed by the AISBL or by one of the host institutions. For an ERIC as a legal entity, involvement of governments is necessary.

A company is being hired to solve all the legal issues, but the management team are realistic in the sense that they recognise that approval of the documents will be the major issue.

EMFL's stated aim is to 'improve collaboration between the facilities, share knowledge, organise networking activities, coordinate user access and bring science in high magnetic fields to the next level'. But the main emphasis seems to be on extending the I3 EuroMagNET II transnational access programme. The main issue appears to be to find funding for the use of the magnets through contributions from countries outside France, Netherlands and Germany.

The project management state that on a longer time scale it may be expected that the new high Tc materials will become mature and may be used for direct current (DC) magnets with fields around 30 T, and that the cost and complexity of these new systems will also mean that they will be found only in dedicated major facilities such as those within EMFL. However, no joint activity plan to pursue these scientific goals was presented.

At present there are about 400 users per year. No single entry point for users exists. At present users go where they want and there is competition between the four locations.

No risk register has been developed.

Recommendations

- The project needs to directly engage with funding agencies and to involve them in planning the research infrastructure. Engaging funding agencies from outside the founding member countries requires a more explicit Stakeholders' Strategy.
- A clear funding model for the coordinating activity needs to be developed.
- The Preparatory Phase will end at the end of 2013 but most of the decisions are still to be made and time seems to be running short for a project that has been on the ESFRI Roadmap for five years. All deadlines should be re-evaluated and progress monitored to make sure they are met.
- The management should focus on finalising and deciding on legal structures and governance because of time limitations.
- The Managing Director should be empowered in the future Governance as much as possible. This should be clarified in the statutes.
- Although a company will be hired to advice on legal issues, it is recommended that the management conceptualise all basic issues and have a clear picture as to what kind of governance is required. In this sense, an important point is the exact relationship between the national facilities and the central body.
- The consortium needs to examine the advantages of setting up a distributed research infrastructure rather than a network with transnational access funding. If the former, then there is a need to develop a truly integrated research infrastructure rather than a collection of facilities with transnational access.
- To have a better chance of success and attract new partners, the project management should consider a plan to develop a truly integrated European research infrastructure for high-magnetic field research, going beyond a collection of very impressive national facilities that are just seeking extra funding to support transnational access. This would show that the participating institutions intend to join together to pursue major scientific challenges in a coherent, complementary and coordinated manner.
- In order to promote a more coherent approach to users, a single entry point for user access should be established.
- The project should think about well-defined KPIs for the project as a whole and for international user access.
- Risks, both physical and programmatic should be considered and a Risk Register developed, if necessary with external support regarding possible organisational issues.

Conclusions

EMFL is approaching the end of its Preparatory Phase, but there is much still to be done in terms of the funding model, governance arrangements, work plan, management, etc. As such EMFL is not considered to be mature at this time. The proponents constitute a network of strong national facilities and although they could have developed a convincing joint work plan, governance and project organisation to become a truly integrated research infrastructure, they have not done so.

The AEG was not convinced that they would change their approach and achieve maturity as a European research infrastructure by 2015.

ESS — European Spallation Source

Key issues and findings

Visualisation from EAST © ESS AB

ESS is designed to be the world's most intense source of pulsed neutrons. Situated in Lund, Sweden it has been on the ESFRI Roadmap since 2006. Its current legal structure is European Spallation Source AB, a public company owned by the Swedish and Danish governments. Some consideration has been given to changing the ESS legal structure to an ERIC. Although there is some political will among the partners to make this change, not all partners appear to agree and at the time of the interview the project management seems worried about the transition to an entirely new governance model now that European Spallation Source AB has been established.

Currently the ESS construction costs are estimated at EUR 1 834 million, including contingency. The operating costs are estimated at EUR 140 million/yr. Sweden, Norway and Denmark will cover 50 % of the cost, mostly in cash. Other countries who have indicated support, but have not yet formally committed, include Germany, France, Switzerland, Italy, Spain and Czech Republic. An independent cost review is being held and will report to the Board of Directors.

The project is ready for a construction decision from the main shareholders, having recently delivered a comprehensive Technical Design Report and Cost Report. The ESS shareholders require that 85 % of the funding (including in-kind contributions) needs to be committed before procurement can start. The managers stated that they hoped that this would be achieved by July-September 2013 so that procurement and construction could begin. The management have not had a role in these negotiations, although they were more than ready and willing to do so.

The project management have to contend with the company Board of Directors and an International Steering Committee composed of over 40 members, that by its very nature cannot act decisively.

The Construction Phase will have to rely on major in-kind contributions from several of the participating countries, therefore coordinating and properly evaluating such contributions will be a critical aspect of the construction. In addition, the goal of 620 staff members at construction peak to be achieved in three to four years seems at the very limit of what is feasible.

The user community has clearly been involved in the ESS project from its early infancy. Annual workshops have maintained good contact with the community. Proposals exist for the access policy, but they cannot be formalised before the ESS governance structure and funding are in place. The location of the Data Management Centre could influence the data-access policy.

Overall, the Risk Report is good for all the risks regarding organisation and recruiting. The organisational risks inherent to international cooperation are addressed, in particular the complex decision process. Technical/design risks are mentioned, in particular regarding the target and its cooling. This is a first-of-a-kind target, viable alternatives are being analysed, but with worse performance.

Recommendations

- Building financial commitments for the construction and for long-term operating budgets, or the development of a detailed Investment Strategy, should move to the top of the priority list now that the Technical Design Report is complete. Delays in starting construction would lead to major cost increases. Delays in decision-making may cost some EUR 10 m/yr just in terms of personnel costs.
- It is recommended that serious consideration be given to recommendation three from the June 2012 review: to co-opt some non-executive directors onto the ESS-AB Board of Directors, who can bring experience of realising and operating international research infrastructures.
- Project performance goals and KPIs should be evaluated again based on the available funding and a phased, fall-back approach should be considered as opposed to simply shutting down the project procurement, if the additional expected financial and in-kind contributions should fail to materialise.
- The Board of Directors should delegate as many of their functions as possible to the highly qualified project management with top-level oversight and guidance from the Steering Committee through a smaller Executive Group that will be able to address the important issues in a more timely fashion.
- Careful consideration needs to be given to whether to make the move to an ERIC or stay with the current status.
- As far as ethical questions are concerned, the recommendation is to set up a separate Ethical Board. Although it is envisaged that the Director-General takes responsibility for ethical issues, such a body could act in a positive way, especially to the general public.
- Implementing the staffing plan on schedule will be a major challenge and should be started as soon as possible.
- Because the project is expected to rely on in-kind contributions for many major components, an independent top-level in-kind committee with real power will be required to ensure that critical items to be procured through in-kind contributions will be supplied on time and in budget.
- If the current situation regarding lack of formal commitment from countries with potentially large user communities continues, then careful consideration will need to be given to balancing open access for the 'best science'. ESS indicates that the spallation source will offer opportunities for new science for new user communities. It is advisable to start attracting such communities well before the Operational Stage, *inter alia* in order to strengthen the case for support by funders.
- Because the location of the Data Management Centre could influence the data access policy, this should be carefully considered in the finalisation of the governance structure.
- The issues regarding the target design, which will become radioactive after its first use, should be reported in the risk assessment. Because of this issue, the licensing process could take longer than expected and should be addressed as a matter of urgency.

Conclusions

ESS is at a very mature stage. Some financial, governance and technical issues remain, but if the recommendations above are implemented the project should be ready for an Investment Decision soon and certainly before 2015.

EuroFEL — Complementary Free Electron Lasers in the infrared to soft X-ray range

Key issues and findings

EUROFEL is a distributed research infrastructure of FEL facilities and has been on the ESFRI Roadmap since 2006. EUROFEL is mostly a networking effort between soft-X-ray, hard X-ray and EUV national FEL facilities currently operating in Germany and Italy (FLASH, SPARC and FERMI), FEL facilities under construction in Switzerland (SwissFEL) and short-pulse facilities under consideration in Sweden and elsewhere. The EU funded Preparatory Phase was completed in 2011. Because FELs have very few beam-lines and managing access throughout Europe will be a much more demanding task than for third-generation synchrotron radiation sources, a distributed infrastructure such as EUROFEL is potentially important. Strong collaborations already exist at the technical-scientific level. Problems seem to be mostly of a 'political' nature at the level of governmental stakeholders. The coordination of the networking activities is supported by the integrated activity CALIPSO under FP7, which it covers the cost of one person over two years starting January 2013. There is no framework for continued collaboration, or funding under FP7.

A very modest central budget is foreseen and a reasonable cost breakdown structure is available. At the present time all EUROFEL activities are financed by in-kind contributions from the partner facilities. The estimated annual costs for the Coordinating Entity are approximately EUR 1-2 million.

The funding model includes both in-kind contributions and also some cash. The suggested annual membership fee is EUR 20 000, to pay for one or two people employed in the headquarters. This would be the minimum requirement, as long as there is no additional long-term funding. The small budget would be sufficient to run the coordination activities. In the past EUR 9 million was given during the Sixth Framework Programme (2004-07), before the Preparatory Phase. They have started to evaluate a new model, with an expert group to think how the R & D collaboration will work without extra money. The partners who will take part in the expert group will also raise the funds for their activities. It is also assumed that costs of joint R & D programmes would be financed by the participating partners or through third-party funding.

There is no assessable governance structure proposal. There are discussions on preliminary statutes for an AISBL before applying for an ERIC; but no definite agreement between partners. All national facilities recognise the need for a stronger commit-

MAX IV @ Lund University, Lund, Sweden

FLASH @ DESY, Hamburg, Germany

ment, sustainable structures and a fully distributed infrastructure as defined by ESFRI. EURO-FEL management have a clear aim, but are not clear as to the steps that they have to take in order to reach it. Once they get to the new consortium structure they will need new MoUs. They also claim they had never come across ethical issues.

The alternative of an infrastructure versus cooperation agreement was addressed during the interview. The project management say that coordination of access can be done better within a research infrastructure than within a network. The AEG were not really convinced of this.

No centralised user facility is planned, and the user community originates from the national infrastructures that have a similar and well-established access policy. The wide-ranging user community is part of several European initiatives that work on harmonising the access policy.

Industrial users are not ready yet to use the research infrastructure. An Industrial User Strategy is not ready.

At present there are no plans to coordinate access to the different national facilities.

The only risk seems to be that funding is not ensured. There are no technical risks since there is a purely coordinating infrastructure. Organisational/ITC risks have not been considered.

Recommendations

- After many years on the ESFRI Roadmap, the scope of the project still needs to be defined and the participating institutions do not all agree on which route to take. It seems that the bottleneck in providing the cash for the centralised activities is related to the fact that the decisions are taken only at the level of the national institutions. This characteristic is typical of a network of national institutions, rather than a pan-European infrastructure. The legal structure, once established should improve this, but this could also require delegating some decisions and resources to the central hub.
- A Stakeholders' Engagement Strategy should address the different options, compare the advantages and disadvantages of all options and undertake a legal and financial evaluation of the selected solution.
- The decision on the preliminary legal structure (AISBL) should be implemented soon in agreement with the stakeholders. If this does not happen, it may be that this whole activity will remain a collaboration between individual infrastructures with perhaps a less formal structure.
- Once the legal structure is defined, the statutes should be completed. The main functions of the Scientific and the Advisory Committee are very general and transparent procedures for nominating and electing members are needed. Responsibility needs should be precisely defined in the governance structures; this is especially pertinent if the AISBL structure evolves into an ERIC once this is acceptable for all shareholders. Operational guidelines, setting the rules for cooperation with national nodes should be also defined.
- An Ethical Board should be envisaged even if it only meets in *ad hoc* situations.
- The added value of establishing a research infrastructure should be spelled out. The AEG considers that the proposed White Paper is essential and urgent. The most urgent activities seem therefore putting together an activity plan, a proposed budget and KPIs for the project as a whole. All these should be independently (externally)

reviewed. A bolder approach to project management might be considered an essential element of any future strategy.

- In view of the many, existing technical and scientific collaborations among the partners, there appears to be ample scope for potential cost savings in coordinating development, procurement and perhaps recruitment at a central level. The consortium should consider these items seriously, if possible within the chosen legal structure. Indeed, if the option is taken to maintain a central EU research infrastructure, some strategic oversight on the national investments becomes important to avoid duplications and ensure cost effectiveness of the shared resources and investments.
- It should be carefully investigated why industrial users are not yet interested in EUROFEL. It might be worthwhile to develop a suitable industrial strategy, and to develop a common point of access.
- Once the legal structure is chosen, a short risk report should be prepared including at least a consideration of organisational risks and missing membership contributions.

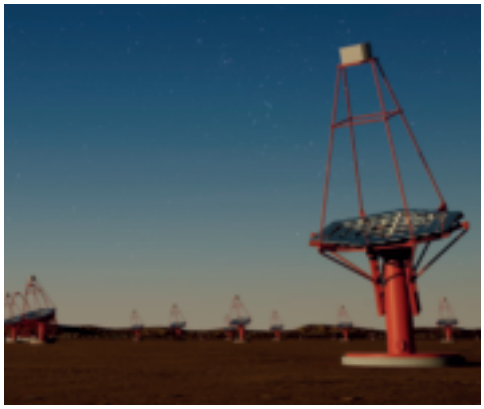
Conclusions

There is much still to be done in terms of the funding model and governance arrangements, the progress since being on the ESFRI Roadmap has not been very impressive. As such the infrastructure cannot be considered as mature at this point in time. The consortium constitutes a de-facto network of strong national facilities and although they could have developed a convincing joint work plan, governance and project organisation to become a truly integrated infrastructure, so far they have not done so. The opinion of the AEG is that there is insufficient commitment to do this.

If the project management keeps to the decision to become an infrastructure, the necessary legal and organisational steps must be taken immediately in full agreement with the stakeholders. Even then, the necessary tasks are very time consuming and the chances of achieving maturity by 2015 are minimal.

CTA — Cherenkov Telescope Array for gamma-ray astronomy

Key issues and findings



Telescope array. Artist's conception.

CTA has been on the ESFRI Roadmap since 2008 and envisages two telescope arrays (northern and southern hemispheres) for ground-based, high-energy gamma ray astronomy. The CTA consortium covers a substantial part of the worldwide scientific community in this area. CTA is a mature collaboration of 27 countries, 171 institutions, and some 1 200 people involved. In 2012, 13 countries signed a Declaration of Intent (Germany, France, Spain, Italy, the UK, Austria, Poland, Switzerland, Japan, Argentina, Brazil, South Africa and Namibia), while it is anticipated that in 2013, 14 more countries will sign (Armenia, Bulgaria, Croatia, Czech Republic, Finland, Greece, India, Ireland, Mexico, Netherlands, Norway, Slovenia, Sweden and the US).

The overall design concept is well developed with an appropriate cost breakdown. Prototyping and site selection have taken a long time and site selection is still ongoing.

The current cost estimate is EUR 152 million at 2006 prices, excluding VAT and institute staff costs. With inflation to the construction period, CTA estimates that updated costs will equate to EUR 190 million (with a 30 % uncertainty mostly dependant on site selection). 29 expressions of interest have been received for in-kind contributions, covering all major components. There is a funding gap between the Preparatory Phase and the first interim legal entity. A common fund has been established to cover this gap. A revised costing will be presented as part of the preliminary technical design report in summer 2013. Operating costs are estimated at 7-10 % of total investment cost. The German funding decision is expected in 2013 at the 20 % range; France, Japan, Poland, Italy, Spain are expected to contribute at the 10 % level; the rest at the few per cent level; EUR 5 million from the EU Preparatory Phase and EUR 10 million from the institutes is now being used for prototyping. It is estimated that after site selection two years will be needed to implement site infrastructure work/contracts, as stated in the presentation.

The research infrastructure is half way through its Preparatory Phase. However, there is no Funding Agreement, just a Declaration of Interest. There are no Statutes as yet. The governance is not fully in place, but future plans indicate a sense of direction. A Resource Board is overseeing the work in the Pre-Construction Stage. There is a good level of representation in the Resource Board with ministries, governmental Agencies, etc. Future bodies will cover all aspects of governance; however, care should be exerted in the setting up of governance structures. At present there is a Resource Board on one

side and a Consortium Board on the other, a possible revision of the relationship of these boards could enhance and ensure full engagements with funding agencies.

Administrative and Financial Committees are preparing for a future legal structure, which will be either an ERIC, German GmbH or French Sociéte Civile. The management seems to be fully aware of all the pros and cons of the possible legal frameworks. The ERIC option seems to be prevailing, but as in other cases with third-country partners, this could depend on foreseen changes in the ERIC model.

Data access is described with guaranteed access provided through in-kind contributions.

An excellent Risk Report has been provided covering technical, environmental, organisational and project management risks, as well as cost risks. Mitigation strategies for the identified risks have also been provided.

Recommendations

- The project needs to develop a clear view of what could be achieved and what the science return would be if less than the full funding were available or if money was available over a longer timescale.
- Developing the commitments is a major, complex project, which should be organised to take account of the complexity. A well-defined Engagement Strategy and Investment Strategy should be defined. Acceptance of in-kind contributions should be made in combination with commitments to deliver on time.
- KPIs for the project as a whole should be developed. This would also help in obtaining financial support, which is one of the major problems at present.
- One of the key issues is to resolve legal matters, that is, to reach a decision on the legal structure, keeping in mind the complexity that involves non-EU members.
- In the future, the detailed governance structure should empower the Executive Director so that the daily functioning of the research infrastructure is not hindered in any way.
- A separate Ethical Committee should be set up not just because of environmental risks, but also as a kind of safeguard in dealing with the local, indigenous population.
- The project schedule may be too optimistic and should be carefully monitored. Major project deadlines, such as the Design Review to be carried out in July 2013, site decision to be made by December 2013, CTA Legal Entity operational by January 2014, Critical Design Review by March 2014, approval of CTA construction by July 2014 and start of construction in late 2014, should be re-evaluated and then met. Risk mitigation strategies should be put in place in the event that such deadlines are not met.
- Site selection should be concluded and hiring started in the immediate future, or the whole project will be at risk. The possibility of the northern hemisphere site not being in Europe should be considered and provisions for such a scenario made.
- A call for tenders to be issued may also potentially slow down project implementation and a procurement strategy should be devised to minimise delays, depending on the legal entity selected by the proposers.
- As for all major construction projects that foresee much of the construction to occur through in-kind contributions, a major challenge will be to make sure that critical in-kind work packages are delivered on time. An independent top-level in-kind committee with real power will be required to ensure that major critical items to be procured through in-kind contributions will be properly valued and supplied on time and in budget.

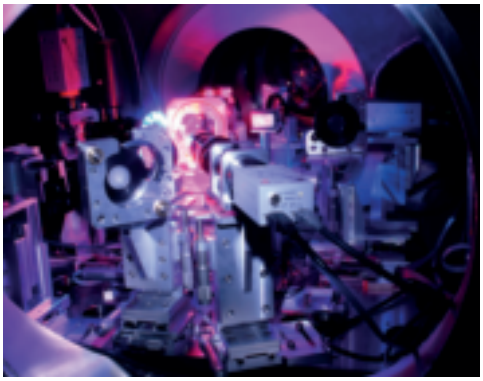
Conclusions

CTA has been on the ESFRI Roadmap since 2008, and is at present half way through the Preparatory Phase. Of the issues covered by the recommendations of the AEG, concentrated effort should be placed on resolving funding and legal/governance issues as well as site selection. Developments in these areas should be assessed once more and checked for progress.

However, if concentrated effort is applied systematically and all of the AEG's recommendations are successfully addressed, then CTA could achieve implementation by 2015.

ELI — Extreme Light Intensity short pulse laser

Key issues and findings



© ELI / FZU AVCR

ELI is a distributed research infrastructure with three sites; in Czech Republic, Hungary and Romania and a planned pan-European Central Coordination with 10 more partner countries in the Preparatory Phase: Bulgaria, France, Germany, Greece, Italy, Lithuania, Poland, Portugal, Spain and the UK. ELI was placed on the ESFRI Roadmap in 2006. It is the only research infrastructure fully located in New Member States.

At present, ELI can be seen as a collection of three major facilities funded from European Regional Development Funds (ERDF) with an evolving Delivery Consortium (ELI-DC) that is expected to help them become an ERIC, thus opening up the possibility of obtaining operating funds. The synergies described in this sense, as well as the ERIC motivation, are based on international access and parallel international funding of the ERIC. The plan is to gain ERIC status by 2018. Joint operations are planned to be realised under the ERIC, that is, the three facilities plus the international associates. Planned costs for construction are estimated at around EUR 781 million. The operating costs of about EUR 80 million are part of the ERIC. This estimate is an approximation based on 10 % of the investment cost and is based on the experience of other similar facilities. The use of ERDF implies a national guarantee of the exploitation cost for five years. In the worst case, the three host countries will be liable for the operations cost for five years.

Quite detailed information is provided for the construction cost and the use of ERDF. Some top-level estimates of operation costs are also provided. However, it is difficult to find details on the central cost of managing a European research infrastructure, or how this will be funded. Interested future partners are listed, but no indication is provided pertaining to the level of interest or likely financial contributions to the central research infrastructure.

Some of the local, national funding has not yet been fully realised and a major timing risk for the overall project has been identified. The hiring implemented to date is well below what was planned at this stage for each of the three pillars and is a major threat to the project. The KPIs put forward were developed to satisfy the ERDF requirements, but are not relevant for the integrated research infrastructure implementation at European level, as the managers are well aware.

In the AEG Questionnaire, governance was dealt with only in broad outlines. The interview provided more insight into the governance structure of the three pillars and subsequently, a Memorandum of Understanding was provided in which it is stated that the 'local' development would be fostered by the national countries.

Due to the regulatory requirements of the ERDF, which impose national oversight and ownership of the assets built using these funds, the three sites will maintain adminis-

trative autonomy. Accordingly, while ERDF are being used, there will be three different research infrastructure organisations with different governance structures. It should be noted that EU regional funding is exclusively country-targeted with no provisions for international activities. An umbrella agreement is planned for the future; however, the steps in achieving this goal have still to be precisely identified.

At the time of the interview, it was claimed that the statutes for an AISBL have been agreed upon almost completely.

Advisory bodies are planned, both at national and international level in the future. No members of the Science Advisory Boards have as yet been elected. An Ethical Board does not exist, but the project managers accept the necessity of such a body.

Many critical issues in common for the individual national projects funded or to be funded from ERDF exist concerning the project management: timing, procurement and recruitment.

The nature of the three separate facilities, despite plans for integration, at present does not leave room for central management. The real added value of treating three separate facilities as a single research infrastructure is not proven.

The political issues related to funding and commitments for an overarching structure (ERIC) are not treated as a (complex) work-package, requiring specific skills.

A good Risk Assessment has been provided for political, organisational, financial and technological risks.

Recommendations

- A long-term operational funding plan or Investment Strategy for the full research infrastructure should be developed and clearly stated. Special emphasis should be put on gaining sufficient commitment from non-host governments. Processes should be set up now for engaging other governments in the funding of the operations.
- Developing plans for future governance of the integrated research infrastructure taking into consideration specific national funding limitations should become a priority.
- A detailed timeline should be decided upon in order to develop the various stages of the governance. At present future plans do not seem to be realistic time-wise.
- Special attention should be paid to a detailed analysis of what the added value is in integrating these three sites and what the final outcome will be. Arguments for the advantages of becoming an ERIC should be clearly stated. The task and responsibilities of the future ERIC should be spelled out clearly and firmly anchored in draft documents. The relationship between the three facilities and the overarching central structure should be addressed in great detail.
- An Ethical Board should be considered very seriously, considering the risks.
- Regarding procurement, ERDF requires a call for tenders. Information should be exchanged promptly between pillars and creative approaches should be discussed to speed up procedures in the case of research infrastructures, together with the DG REGIO and DG RTD. An international procurement task force may help with legal issues and with strategies to minimise the number of calls for tenders, overcoming different approaches at the national level and thus avoiding litigations.
- Priority for ELI-DC should be given to targeting coordination issues at the national and EU level and monitoring the individual project implementation. There is little chance

of starting an ERIC-building exercise, if one cannot get the individual projects on track. KPIs developed by the individual projects to justify the use of ERDF should be replaced by KPIs for the ELI research infrastructure as a whole.

- A detailed plan and steps for achieving successful recruiting should be put in place. The need to hire hundreds of competent scientists and engineers in the three countries is a big challenge and the task might be made easier by an ELI-DC organised international recruiting task force.
- User Strategy and an overview of the user community plus user and data access policy should be developed further, especially keeping in mind the integrated future research infrastructure. The project should get an overview of the user community and the way user and data access will be handled.
- The statement: 'the European laser community has mandated HU, CZ, RO' should be operationalised and be transformed into commitment from the community to the use (and payment of access fees) of ELI.
- Risk Assessment should be developed further with special reference to potentially risky outcomes of operations. A good explanation of further risks would be welcomed, as well as an elaboration of the application of nuclear security standards, although in the interview it was claimed that this was not an issue. Specific future possible risks should be clearly stated and risk management developed.

Conclusions

The specific nature of ELI, with specific reference to the regulatory requirements of ERDF, implies that issues of maturity have to be viewed from two different perspectives. Firstly, the development of each individual site will have to adhere to the country-targeted regulations of ERDF and in some cases this has not yet been fully realised. This implies that all issues pertaining to individual site development have to be addressed and finalised. Secondly, ELI plans to gain ERIC status by 2018, implying joint operations to be realised through the three facilities plus international associates. Although documents have been provided that indicate how the ELI-DC could be set up, issues of funding, governance, stakeholder engagement and user strategies still require further development and concentrated, focused efforts.

Although strictly speaking implementation of the full integrated European research infrastructure is not possible by 2015, primarily due to the limitations inherent in structural funds, ELI could be on the way to achieving maturity as a European research infrastructure if the ELI-DC coordinating effort works out. However, careful monitoring, as well as concentrated efforts on all counts of the AEG's recommendations will be needed.

KM3NeT — Kilometre Cube Neutrino Telescope

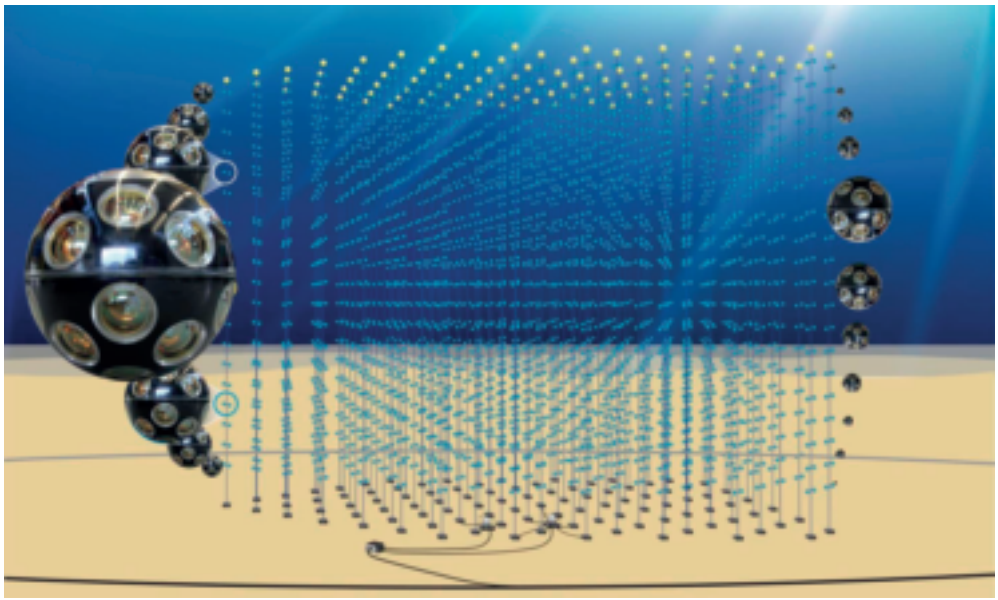
Key issues and findings

KM3NeT has been on the ESFRI Roadmap since 2006 as a European research infrastructure for neutrino astronomy as well as earth and sea science. The stated main purpose is to build an underwater detector to map neutrino sources in the galaxy. The management state that they will have better location(s) and higher sensitivity than the US. IceCube facility, which was completed early in 2011. The material provided and statements made during the interview indicate that the project's main interest is to be the first to observe an astrophysical source of neutrinos in the galaxy.

The current estimated cost for the full detector is EUR 225 million including 20 % contingency but excluding VAT. At present some EUR 40 million is committed, which is sufficient for Phase 1 of the project. There is, however, neither the demonstrated commitment nor expressions of interest at this stage that would enable the construction of the full KM3NeT. It could be argued that the Phase 1 investment is R & D for the full KM3NeT, which itself would need to run for several years to achieve the main physics goal.

The major risk is lack of funding and this has yet to be addressed satisfactorily. The project would like to have a substantial EC contribution. There is the hope that the present stakeholders will significantly increase their contribution and that new partners will come in from both Europe and elsewhere but at the moment the management do not know where the money will be coming from.

The current governance model is based on that used for large high-energy physics projects. This does not seem appropriate for a stand-alone facility such as KM3NeT, which does not sit within a large host laboratory. Issues of overall responsibility are not clear



Artist's conception of the neutrino telescope of the KM3NeT Research Infrastructure. A total of about 640 string detection units supporting an array of about 12800 Digital Optical Modules (DOMs) anchored in the deep seas of the Mediterranean for measuring the faint light of charged particles created in the collisions of neutrino's with the matter inside or in the vicinity of the telescope. © KM3NeT Collaboration

and should be worked out in order to attain a logical structure. In particular a suitably empowered management capable of building the infrastructure needs to be put in place.

The managers state that they are preparing for an ERIC, but it is not clear how binding the commitments are and whether the governments involved are willing to sign up to an ERIC. They have approximately a year and a half of the current phase in front of them and it does not seem realistic that they will reach the ERIC level by that time.

To date there has not been an overall detailed cost review. The management say that their funding agencies allow them to do a 'component by component' cost review. This has allowed procurement to start, which is a major concern for this project. Additionally there has not been a review of the EUR 40 million structural funding as a whole, though each element has been reviewed by national authorities. This is a further concern.

In the framework of the Preparatory Phase, the progress of KM3NeT was reviewed in February 2012 by an independent, external expert panel, the Scientific Standing Committee (SSC). Several of the SSC recommendations concerning project management and HR policy have been addressed only in part and remain very appropriate today.

No activity plans, budgets or KPIs are available for the different complementary earth and sea science activities envisioned for the research infrastructure. Neither the proposed International Review Board nor the proposed Science and Technology Advisory Committee have yet been appointed.

The various groups within KM3NeT still do not appear to be cooperating in a sufficiently coherent manner and it is unclear how easy it will be to manage a three-site operation.

The main user community will be the members of the KM3NeT collaboration who will have priority rights to the neutrino data but it is envisaged that other interested researchers will be able to propose observational campaigns. Collaborative links with other neutrino observatories including IceCube are under discussion.

In relation to other ESFRI research infrastructures, the marine community involvement is said to be via EMSO, but this is not mentioned in EMSO documentation. Given the funding status of EMSO, expectations for substantial contributions seem unlikely.

The project has good Risk Assessments on individual risks where experience in operating other similar infrastructures exists. These possible failure risks refer to operation and have been taken into consideration when the operation costs have been calculated.

Recommendations

- There is an urgent need to engage with funding agencies and governments to determine the likelihood and timetable for funding before committing significant funds to Phase 1. The management team should urgently develop a work-plan for obtaining the commitments for the full funding or well-defined Delivery and Investment Strategies. They should also obtain legal help to address major issues such as VAT treatment and ownership of the equipment procured through structural funds.
- The project should consider re-examining the management and governance structure to provide clear lines of responsibility. The current model is based on that used for high-energy physics experiments but this might not be the best approach for a facility

that does not sit within a large host laboratory and is supposed to also cater to the needs of the earth and sea science community.

- Although a site-neutral leadership is now in place, there is some evidence that the various groups within KM3NeT still do not appear to be cooperating in a sufficiently coherent manner. A consensus-building path towards a well-led and well-managed project needs to be established, as per the SSC recommendation.
- The single research infrastructure on three sites concept should be transformed into a solid management plan. The role and scope of ERIC *vis-à-vis* the three sites should be defined, also with regard to procurement.
- It is recommended that an Ethics Board be set up to monitor the proposed activities including plans for decommissioning. The project management feel that it is not needed but given the sensitive nature of marine environments this should be re-examined.
- There should be an overall, detailed cost review of the project before significant funding is committed. Clarity should be sought as to whether the whole of the structural funding should be seen as a single major project. Appropriate technical assistance mechanisms should be sought, where appropriate.
- It is urgent that the proposed International Review Board and Science and Technology Advisory Committee are appointed, so that an independent international scientific and technical review and an independent project cost review are undertaken, as per the SSC recommendation. The reviews should also address the risk analysis. A positive result of such reviews seems essential to boost confidence that a project implementation phase would be successful in cost, schedule, and performance. Although the operating costs are very modest compared to the construction costs, these should also be reviewed.
- Activity plans, budgets and KPIs should be developed for the different activities envisioned for the research infrastructure. Even if KM3NeT were to be just a facility for mapping neutrino sources in our galaxy it is recommended that the project develops a more defensible, long-term approach and identifies KPIs for the mapping exercise.
- Formal talks with EMSO should be started, if EMSO is the preferred link to the marine community. It will be important to address priority issues between environmental and neutrino observation.

Conclusions

KM3NeT could be considered mature in a number of respects, as it has secured funding for a Phase 1 technical demonstration. However, in order to achieve its physics goals several years running would be needed with the full detector. There is an urgent need to determine the likelihood and timing of securing the funding for this next phase. In the absence of such funding, there is a risk that the current investment will not yield any scientific return. At the minimum there needs to be a detailed cost review of the current phase before funds are committed. An independent international scientific review is recommended.

KM3NeT has clearly not yet reached maturity particularly with regard to funding the full instrument and the AEG believes the chances for achieving maturity by 2015 to be minimal.

SKA — Square Kilometre Array for radio-astronomy

Key issues and findings

SKA is a multi-stage, dual-site infrastructure (the antennas are distributed over two continents) aiming at new fundamental results in physics and astrophysics. It has been on the ESFRI Roadmap since 2006. The Approval Phase has started and is scheduled to end in 2016. It is running late at this moment, but schedule recovery actions have been taken.

ASKAP: The CSIRO's Australian SKA Pathfinder (ASKAP) telescope, located at the Murchison Radio-astronomy Observatory (MRO) in Western Australia. ASKAP is composed of 36 antennas and is one of the precursor telescopes to the SKA.

Good costing and financial arrangements are in place for the Approval Stage, where detailed costs and funding models for the Construction Stage will be defined. The current level of commitment is EUR 25 million funding of the project office and pre-construction work, which is considered well-funded. Most of the design work in the Approval Stage will be done via in-kind work packages valued at EUR 87 million through individual in kind contributions. Consortia are in the process of being formed in response to a call for provision of design/resources, which has now been issued. Responses are expected in June 2013.

The Board of Directors has done a good job of ensuring funding for the pre-construction. Good contacts exist with the funding agencies and governments concerned. However, there will not be enough cash in the project office to fund gaps in the match between the in-kind offers and the WBS, but there is good communication with the consortia and gaps are expected to be small. South Africa and Australia will keep resources that should ensure that gaps will be filled.

Funds for construction have yet to be identified and secured. In-kind contribution for the Construction Stage is a point of active discussion; the aim is one-third cash and two-thirds in-kind. The antenna contract will be one of the largest contracts (EUR 150 million), which exceeds by a factor of three the maximum contribution of any country.

Governance structures are defined for the current phase while the long-term governance structure is under review. The legal status is at present a UK Limited Company. This might be changed in the Construction Stage. An ERIC is not possible until a satisfactory solution for inclusion of non-EU countries has been decided. A solution should be found for a legal structure in the future that could operate two remote facilities. Finance and Executive Committees are being established, KPIs are defined. Key managers and other staff (approx. two-thirds of the total) are in the process of selection.

The pre-construction approach seems sound and the size of the in-kind commitments is less worrisome than it is for the Construction Stage. The proposal shows a professional strategy in every regard; a system engineering development plan is leading the activities.

SKA enjoys high political commitment and research council involvement, good relations with governments and funding agencies.

The SKA user community is not only the global radio astronomy community, as there are several users from physics and geophysics. Access policy has not been established yet, but should follow the same guidelines as for other publicly owned telescopes. Commercial users are not foreseen. There is an analysis of the possibilities to develop a reasonably sized user community.

Recommendations

- The main problem will be to find enough countries to support the financing of the SKA construction. Efficient lobbying and good publicity by all the present and future partners will be required.
- The work-package to get the necessary funding commitments (part of transition phase goals) has not been elaborated yet, but it is crucial. The scale of the necessary commitments (>EUR 1.5 billion), are likely to take a lot of time to achieve (especially in the current economic climate) and will require a process involving high-level government participation. The Investment Strategy should be led by someone having the necessary international diplomatic and political skills in addition to technical knowledge of the project.
- To progress from the design, Approval Phase to the Implementation Phase, it will be essential to directly involve the funding agencies for all countries including those not yet involved. A mitigation strategy should be devised in relation to the possibility that some of the partner institutions will not succeed in obtaining governmental support to cover construction and operating costs. To define the institutional form that will be adopted for construction seems urgent to be able to involve other paying partners.
- The cost increase stemming from the two-site decision and the operating costs (including data storage and access costs) should be firmly established and independently (externally) evaluated in the near future if more partners are to be convinced to come on board. Well-proven cost engineering procedures should be used to obtain reliable figures for the construction phase.
- The chosen legal and governance model may also be suited for the Construction Stage. However, evaluation of the further development of a legal entity and a governance structure is necessary and should take into consideration the diversity of present and future partners. An Ethical Committee is recommended within the governance structure because of possible environmental issues and indigenous peoples living in the mainly desert areas where the antennas will be erected. Possible problems could arise pertaining to these issues.
- Staff policy seems okay, but the 70-person staffing plan at the SKA Office at Jodrell Bank Observatory needs to be implemented followed by the development of a staffing plan for construction at the sites and the following operation, *inter alia* to firmly establish operating costs.
- The international legal and administrative skills required to monitor and assist the different partners should not be underestimated. The same will be true for quality control and manufacturing supervision. Exchanging ideas and experiences with CTA should be considered. Regarding contractors and participating organisations, legal advice should be sought to find the most effective ways to make sure that the deliverables from participating organisations are produced on time and within budget and the in-kind contributions are properly valued at international standards. The AEG strongly encourages the management to consider establishing an international procurement task force to monitor and assist the partners responsible for critical work-packages.

- A Risk Report dealing in detail with the organisational and procurement risks in the Construction Stage should be added to the present, carefully elaborated Risk Report. It is already clear that the very high data rates from the telescopes and the corresponding energy needs for the very remote sites are challenging and require special efforts and innovative ideas. The Risk Report should also focus on the technical and cost part once the pre-construction is more advanced and the chosen designs have converged. The IPR component of such developments has applications far from the scientific areas and could even become politically important in the regions where the antennas are placed.

Conclusions

The SKA can be considered as being close to maturity, provided the conditions set in the first five bullets of the recommendations are achieved and the other recommendations taken on board for action in the short term.

Besides the difficulty to convince enough countries to become members of SKA, the necessary step for Investment Decisions (technical design finished and frozen, technical specifications ready, sites prepared, cost assessment stable and reliable, financing based on shareholders' hard commitments) are considered as major bottlenecks to be overcome during the Approval Phase.

If the ARG's recommendations are acted on, then SKA could be ready for Investment Decisions and hence implementation by 2015, though securing financial commitments by then will be a major challenge.

4 SUMMARY AND CONCLUSIONS

4.1 General considerations and final Assessment

In its analysis of thirty-five research infrastructure projects on the ESFRI Roadmap, the AEG was asked to address two inter-related, but very different issues. The first issue: evaluating the financial and managerial maturity of each individual project identifying specific bottlenecks and making recommendations on how to best address them, required the AEG to examine and discuss in detail the available information at the time of the interview. The resulting assessment of the status of each project and the related recommendations are summarised in the individual reports in Chapter 3. The second issue: indicating the feasibility for these research infrastructures to be ready for implementation by 2015, required an extrapolation of the existing data to the probable situation likely to prevail in 2015 or afterwards and therefore to some extent a judgment of the project management ability and determination in implementing the AEG recommendations. The summary assessment at the end of each individual report in Chapter 3 summarises also the main issues and the views of the AEG about the likelihood that each project would be ready for implementation by 2015 or at a later stage.

For the purpose of this report, a research infrastructure project is considered to be 'mature', i.e. ready for implementation, when it meets the main criteria as listed below:

- Cost and financial plan are well defined, with adequate cost estimates;
- Firm financial commitments exist for the relevant investments and operations;
- Approved statutes and governance structure are in place;
- Existence of a credible project organisation, with clearly identified responsibilities and reporting lines;
- KPIs are established and staff planning outlined, including procurement considerations;

- User strategy is well planned;
- Risk analysis is included.

These are the minimal criteria that a funding agency would expect a project to meet in order to allow a positive investment decision, which, in turn, would lead to implementation and operation. They do not coincide, however, with other criteria used in the past to consider the research infrastructures on the Roadmap 'under implementation', such as those introduced by the ESFRI Implementation Working Group, or by the Innovation Union Flagship Initiative ('completed or launched the construction'). In addition, the submission of an ERIC application by a given research infrastructure, or even its approval by the European Commission, although a clear indication that suitable statutes and governance structures are in place, does not necessarily imply that the other criteria above have been met.

The implication is that projects considered under implementation by other bodies, experts or working groups, or that have initiated construction and have received funding under national or EC structural funding schemes, or have established an ERIC, may or may not be considered mature by the AEG.

In the context of the current report, maturity refers to a state of readiness in terms of the criteria listed above and therefore, this implies that the research infrastructure is ready for implementation only when the research infrastructure has reached sustainable maturity. In other words, there are sufficient financial commitments to cover the operational costs during implementation and the governance or adequate provisions for this, user strategy, risk registers and management structure are adequate for handling the many challenges a research infrastructure will incur during its lifetime.

Few of the research infrastructures examined meet all of the above criteria, but some are not far from this and are likely to be ready for implementation by 2015 provided that certain specific points are addressed. Most projects are between the Business Case and Investment Decision Stages, implying that they meet some of these criteria, but more work is necessary to reinforce the research infrastructure before it starts operations.

Therefore the AEG has identified three groups of research infrastructures, in terms of the actions necessary to make these projects ready for implementation and the likelihood that this could be achieved by 2015. This classification has to be seen in dynamic terms, as the projects are continuing to make progress, while the AEG assessment represents a snapshot based on the documents received at the time of the interviews, i.e. between December 2012 and March 2013.

- A set of eight research infrastructures could meet the above criteria with some effort, if the AEG recommendations were pursued, so that they are likely to be ready for implementation by 2015. However, even for these research infrastructure projects close to maturity, financial commitments are often not guaranteed. Therefore financial maturity remains, in many cases, a key issue to be addressed by stakeholders. These research infrastructures are: BBMRI, EISCAT-3D, ELIXIR, ESS, EURO-ARGO, IAGOS, INFRAFRONTIER and SKA.
- Eleven projects require substantial efforts to address all AEG recommendations and to be ready for implementation by 2015. The implication is that it will be comparatively difficult for them, but not impossible, to reach maturity by 2015. Some of them might be ready for implementation at a later stage, because to be at the Business

Case Review stage today might imply opportunities to reach operations after 2015. These research infrastructures are: CLARIN, CTA, DARIAH EATRIS, ECRIN, ELI, EMBRC, EPOS, ICOS, INSTRUCT and LIFEWATCH.

- For sixteen projects, only few — if any — of the criteria expected to be satisfied in Approval Phase have been met and the AEG believes that their chances to be ready for implementation by 2015 are minimal. These include research infrastructures that recently entered the Preparatory Phase (ANAEE, EU-SOLARIS, ISBE, MIRRI and WINDSCANNER) or still are in the Preparatory Phase (ECCSEL, EU-OPENSCREEN, EUROBIOIMAGING and SIOS), and may not have had sufficient time to make sufficient progress in the required aspects. In other cases (ERINHA, EUROFEL, EMFL and EMSO), although the participating institutions could have developed a joint work-plan, governance, and project organisation, they showed insufficient inclination to do so. The AEG was not convinced that they would change their approach and achieve maturity as European research infrastructures by 2015. In the remaining cases (COPAL, HiPER, and KM3NeT), the projects have made so little progress toward their stated target over the years or such major recent changes in scope and/or approach relative to the original submission have taken place, that the AEG considers their chances to achieve maturity by 2015 to be minimal.

It should be noted that belonging to second or third category does not necessarily imply that a lower priority should be assigned to supporting such projects, in view of the fact that any prioritisation should start by considering the scientific importance and the societal impact of the research infrastructures, both aspects that have been specifically excluded from this exercise. Also, planning the establishment of a research infrastructure takes time, and some of the research infrastructures have been on the Roadmap since 2006, and are only now starting to approach maturity, after a long Preparatory Phase.

The recommendation most frequently put forward in this report (for over two-thirds of the proposed research infrastructures examined) is that once a reasonable activity/implementation plan has been developed with an appropriate work-breakdown structure, governance, financial strategy and user strategy, all such aspects should be independently (externally) evaluated. This is partly a reflection of the fact that it is often unclear what kind of screening has been performed in the past to put the proposed research infrastructures on the Roadmap, or to fund the Preparatory Phase, or to decide that ten projects on the Roadmap should be considered under implementation. An independent scientific and technical review and an independent project cost review, taking into account the risk analysis, could benefit all projects on the Roadmap without exception. A positive result of such reviews will be essential to bolster confidence that a project Implementation Phase would be successful in cost, schedule and performance.

4.2 Project Scope

The documentation provided by several distributed research infrastructures contained general statements about activities and best practices, but few specifics about the work plan. In some cases the only clearly identified target seemed to be to get several national institutions active in the same field in different countries to talk to one another in the framework of whatever legal entity they felt comfortable with. This reflects the fact that often coordinating the activities of well-established national institutions in different countries is really difficult. It does not imply that the research infrastructures were launched solely to benefit from the EU funding. However, without a reasonable activity/implementation plan specifying the roles of the different partners and detailing the value added of the research infrastructure, it is difficult to justify a European dimension and an Invest-

ment Decision. In other cases the agreed work-plan appeared to have been built by simply collecting the national initiatives, in a patchwork approach that did little to clarify the role and European added value of the research infrastructure, and in the absence of any strategy to enhance impact and rationalisation on national decisions and programmes.

In general, a major methodological difficulty occurred when assessing most distributed research infrastructures. Major investments are being made at the national level, so for many distributed research infrastructures the central hub, or European dimension of the project, is relatively small at least in financial terms, as compared to the national main components. Whenever the national investments are kept within the scope of the European research infrastructures, it is often difficult to verify the size and assess how firm the national commitments really are. Moreover, a trade-off often exists between the desire of the national node(s) to 'control' the national investment and the overall objective of the research infrastructure that includes optimal use of national resources at European level. Many distributed research infrastructures are hesitant to create strong influence of the central hub on the national nodes. This might be a tactic to avoid problems of power distribution at an early stage, but it is not the best way to create a truly European infrastructure, whose strategic reach and importance should go far beyond that of the individual nodes (national infrastructures).

The delicate relationship between the national nodes and the central hub often needs to be better defined, as a way to clarify the scope of the research infrastructure and its criteria for success. Without these boundaries being well defined at European level, it appears difficult to talk about European research infrastructures, instead of a network or even just a collection of national nodes. In Chapter 3, comments are included about this very aspect for the majority of the distributed research infrastructures. Because it is the coordinating role of the hub that will make the research infrastructure function (in terms of governance, legal, financial, IPRs, and stakeholder issues), a plan to strengthen gradually the hub should be developed, achieving a balance between autonomy of nodes and hub, involving as much as possible the national nodes from the start to avoid that the nodes/Member States may see a stronger coordination as a threat.

An important aspect addressed by some research infrastructures in the life sciences is the standardisation of best practices across the participating national nodes in the framework of the agreements required to establish the research infrastructure in the first place, or to add new national nodes to the research infrastructure. Negotiating agreements with every national participating institution could be a very sensible way of promoting standardisation and quality assurance and a European dimension in distributed research infrastructures.

4.3 Financial and Stakeholder Support

An aspect of maturity of capital importance that many projects failed to meet at this stage is financial maturity. Few research infrastructures can show firm financial commitments for the relevant investments and operations from prospective partners, stakeholders and funding agencies. This is in stark contrast with the fact that many projects indicated that a major motivation for the establishment of a research infrastructure is to achieve visibility at the international level that would yield some type of priority at the national level and secure long-term financial commitments from the national governments and/or funding agencies. Several other findings and recommendations about financial and stakeholders support put forward in Chapter 3 are also of more general significance.

Often, during the interview process it emerged that there was no clear 'action plan' at European level, nor at national level, on how the research community should engage with the stakeholder community to have a project approved and funded. Seeking real engagement and commitment from stakeholders and funding agencies often occurs too late in the project, leading to delays, misunderstandings and potential disappointment. This often reflects weak links between the project leadership and national governments and a lack of knowledge of how the political process works. This in turn leads to unrealistic assumptions regarding the number of Member States ready to participate in the new research infrastructure. On the contrary, the AEG believes that a convincing Investment Strategy and an Engagement Policy with stakeholders should be developed early to pursue commitments at government level.

There are many different approval systems at national levels for funding research infrastructure projects. Sometimes commitments have been made at the level of the research institutes involved, sometimes, the commitments have been part of a national roadmap, and in some cases, the funding has been secured at the level of the Ministry of Research or other Ministries. Well-defined rules on 'who-does-authorise-what-by-when' are essential to avoid loops, where everybody waits for decisions to be taken by others. Even if some countries have well-defined rules and a model for approving funding, it is sufficient that one member of the Consortium not complying with the mechanism of transparency in the approval process of engagement with the stakeholder community can create problems for the research infrastructure as a whole. Credible parameters to monitor performance and target values for such parameters as KPIs for the project as a whole and for the user base expansion should be developed, also as an important tool to document the value added. This should be treated as a work-package in itself, requiring leadership with appropriate skills.

In several research infrastructures with a mainly academic user base, but proposing activities of obvious potential interest to industry and to the private sector, there appears to be a variable degree of uneasiness about the role of possible industrial sponsors. In modern times and in view of the emphasis that the European Union and governments worldwide are putting on societal impact and economic development, the diffidence towards the private sector seems outdated and difficult to justify. In some cases, the direct involvement of the private sector could be a useful avenue for expanding the activities, funding and societal impact of the planned research infrastructure.

In view of the difficulties encountered in achieving financial maturity, many research infrastructures propose to use a whole range of financial instruments, including grants from national funding agencies, structural funds and — far too often and optimistically — contributions from the European Commission under Horizon 2020. Some research infrastructures propose to use EIB financing as a mitigation strategy, without a clear prospective of who will be the borrower and where the money to pay back the loan will come from. The resulting potentially poor synchronisation of funding decisions from different sources is a major reason for potential or actual inefficiencies. A fundraising strategy to mitigate the consequences of this should be a project work-package, and in all cases, mitigation strategies should be put in place in case fundraising is only partially successful. This is sorely lacking in most of the research infrastructures examined.

4.4 Governance

Many research infrastructures — including some that have concluded the Preparatory Phase of the Seventh Framework Programme — are still discussing with prospective

partners and stakeholders the type of legal entity they should establish and the governance that should follow. In some cases such issues are taking second place to the elaboration of a business plan or financial considerations. However, the legal entity to be pursued and the governance to be implemented are some of the issues that take the longest time to be negotiated with prospective partners and stakeholders. At the moment, issues of this type are hindering, for example, participation in the ERICs of several EU national governments. Governance and legal issues should be dealt with in the early stages of project preparation and should not be left to the emergency measures, like a last-minute hiring of a private consulting firm at the end of the Preparatory Phase. External advice would be very helpful at an early stage in this regard.

At the moment, major research infrastructures seek consensus among the stakeholders by having often large Steering Committees which interact directly with the Board of Directors and project managers. Large Steering Committees of up to forty and more national representatives are however, unlikely to be effective at any operational level and will simply hinder good project management.

Different types of governance can be envisaged for the different types of research infrastructures, but following a few simple principles should be followed in all cases and should be enshrined in the institutional by-laws.

Directors should have enough power to function as true executives. Clear lines of responsibility should be ensured in whatever governance structure is to be implemented.

For the distributed research infrastructures, adequate mechanisms and procedures should be pursued for managing the relationships between the centralised governing bodies and the national authorities. Service level agreements should be negotiated to establish the process flow. This is especially important in highly regulated fields such as medical and life science-related research infrastructures.

Because independent reviews of all investment decisions and operations are an essential aspect of all good governance and project management, transparent procedures should be implemented for nominating and electing all Boards, and especially for Scientific and Technical Advisory Boards.

Often future liability issues can be avoided by establishing within the governance structure an Ethical/Bioethical Board, but comparatively few of the research infrastructures examined have considered this. Together with the widespread absence of a risk analysis, the reduced sensitivity to ethical liabilities seems to be characteristic of many research infrastructures active in physics, chemistry, material sciences, humanities and, more surprisingly, in environmental science. This shortcoming should be addressed with urgency, as research infrastructures will be international organisations accountable for their operational activities to the full community of direct and indirect users. Reputational risks should be managed and mitigated via ethical bodies, also including members of the local communities.

Legal due diligence and options analysis about site selection needs to take place early in the research infrastructure design stage. Site selection has major implications for the governance and legal entity selection, and may dramatically affect project cost and schedule, both in a positive and the negative sense.

Conversely, coordination with other worldwide initiatives in the same research area would often expand the significance of the EU research infrastructure and should therefore replace competition to be first at the finish line.

4.5 Human Resource Policy and Project Management

The emphasis on getting national institutions to talk to one another sometimes seems to be getting in the way of developing a convincing work plan for the research infrastructure as a whole. More than 50 % of the projects examined presented a work plan that provided insufficient specifics about the actions that the European research infrastructure intended to implement or appeared to be largely a collection of plans developed independently by the individual institutions participating in the project. As such, the work plans did not clearly show the value added by the establishment of a research infrastructure and it is doubtful that they would serve the purpose of convincing new partners and stakeholders to participate. Several other findings and recommendations put forth in Chapter 3 are also of more general significance.

Some 40 % of the research infrastructures examined still need to develop credible KPIs for the project as a whole. Many research infrastructures propose parameters to monitor the research infrastructure progress and achievements, but fail to identify target values for such parameters. These are needed in order to assess the degree of success of the project and document the added value of the proposed research infrastructure to prospective stakeholders and funders. Whenever defined, the proposed KPIs often completely neglect to take into account user access and societal impact.

Several research infrastructures planning the development of a large physical infrastructure depend on large in-kind contributions from the participating institutions. This exposes the project to the risk that crucial components might be late, therefore delaying the development of other crucial elements and negatively affecting the project schedule and cost. The hiring, procuring and spending related to the in-kind contributions from the different participating institutions should be assessed and monitored by an in-kind committee or project office with real powers, and interface documents should be developed to make sure that the contributions are properly valued and delivered on time and within budget.

For all distributed research infrastructures, care should be taken to minimise the project cost increase that may derive from splitting the planned major procurement into individual contracts of national nodes with suppliers. This is sometimes compounded by the stringent time constraints for the use of structural funds or other types of financial instruments and the incomplete definition of the 'fast-track' procurement procedures that projects hope that ERICs would be allowed to use. A reasonable procurement plan, describing specific initiatives to bring the project to the Implementation Stage on schedule, should be developed and independently assessed. The support of an international procurement task-force might be warranted for multi-site research infrastructures.

Coordination and collaboration with other research infrastructures on the Roadmap is often little more than an intention, with few specifics given. This is unfortunate, because proposed hiring plans and HR management are sometimes unrealistic, orders of magnitude below target in many new countries of the EU, and the research infrastructures could benefit from collaborations to attract, retain and share crucial personnel. Many projects still in the Preparatory Phase might benefit from a work package to establish and exploit such collaborations in the area of HR policy, project management, procure-

ment, database development and user access, but also complementarity in services, increasing the scale and hence visibility and attractiveness to stakeholders of the research infrastructure. The scientific added value of closer collaboration between research infrastructures should be proactively pursued, notably by projects in the same sector.

Few research infrastructures have conducted a truly independent (external) assessment of their activity/implementation plan, work breakdown structure, governance, Investment and Delivery Strategies. An independent scientific and technical review and an independent project cost review, taking into account the risk analysis, would benefit all the research infrastructures on the Roadmap and could hopefully show that a project implementation phase could be successful in cost, schedule and performance.

4.6 Users

Although most of the research infrastructures examined claim that they will implement an open-access policy with the usual peer-review screening of user proposals, many research infrastructures — and not only those in the Preparatory Phase — do not appear to have developed a comprehensive view of their prospective potential user community. They do not appear to know the origin of their users nor the size of their prospective user community, and have not clarified any overlap with the user community of other research infrastructures on the Roadmap or worldwide. Several other findings and recommendations proposed in Chapter 3 are of more general significance.

A project should assess the existence of a user community of sufficient size and relevance, and document the added value of the research infrastructure for them. The research infrastructures should develop a comprehensive view of their prospective user community as early as possible, i.e. as part of the Concept Screening Stage.

Once a comprehensive view of the prospective user community has been obtained, a well-defined User Policy should be developed. Both scientific and ethical goals should be considered, when applicable, and user-related KPIs should be defined.

The role of the initial and future user community in an international perspective should be assessed. For all of the above aspects, contacts with selected user groups should be sought at an early stage, even establishing formal links to the prospective user community.

Very few of the projects examined have a user training programme in place. Developing a centralised programme for user training would have a substantial positive impact on the size and diversity of the user community, in particular expanding the research infrastructure utilisation to other thematic areas.

Although all research infrastructures tend to produce large amounts of data, and this tends to impose significant requirements on the ICT infrastructure and increase the cost of data storage and the risk related to data protection, few research infrastructures today are taking appropriate measures to address these aspects. Projects should develop a well-defined data handling policy for both centralised and distributed research infrastructures and perform an appropriate risk analysis during the Preparatory Phase. Synergies with research infrastructures operating in the same field should be pursued, by ensuring common standards.

Synergies in building up common operational ICT platforms with other research infrastructures should be pursued to ensure modularity and cost efficiencies.

Related to promoting services to the academic user community, but also to enhance the participation by the private sector and the commercial exploitation of the results, projects should develop a well-defined data access policy for external users at both centralised and distributed research infrastructures and perform an appropriate risk analysis concerning data confidentiality and integrity and IPR protection, which is essential for industrial users.

Linked to the issue of governance, corporate social responsibility policies and communication strategies should be put in place to minimise reputational risks arising from wrong data handling and to manage the relationship with the public and regulatory authorities, concerning sensitive data.

4.7 Risk

The achievement of scientific goals in both basic and applied research can never be guaranteed so that the impact of scientific research infrastructures is inherently somewhat risky. Here, only the experience and the intuition of top scientists can give confidence to those having to support the project that important novel results will be obtained. Only the scientific proponents can do a substantial risk assessment of achieving the scientific goals and only a scientific peer-review of specialists in that research field could give substantial advice. In the more conventional fields needed to design and operate a research infrastructure, risk assessment can give a good picture of the likelihood of problems and of their sources. When dealing with management, organisation and procedures, engineering, ICT, cost engineering, quality control and reliability, market opportunities of services, administration (financial business, HR, procurement), safety and security etc. experience in those fields provides specific know-how and well-proven procedures to assess the probability of an infrastructure working smoothly, identify critical issues and select mitigating strategies to be put in place. Several other findings and recommendations reported in Chapter 3 are also of more general significance.

Risk considerations require a very in-depth knowledge of the organisation of the planned infrastructure and/or the technologies and the design of the technical facilities. At the time of applying for approval/financial support of an infrastructure, only the proponents can present a fairly reliable first risk list or report and should be expected to do so.

Some 50 % of the projects examined had performed no risk analysis at all, and therefore had no credible mitigation strategies in place while a further 30 % had performed only a partial risk analysis in some selected areas. Many of the risks — not only in technical infrastructures — can be identified only at a later stage of construction or even only during operation. A Risk Report therefore always requires a staged approach. With the organisation further maturing, new risks come up in more 'conventional' fields, where a lot of knowledge in fields far from the main discipline of the planned infrastructure is required. The management in many cases are not strong in such fields because of lack of experience and expertise. Here it is essential that help is sought from experts. Many of the possible risks at this stage are standard in industrial environments and assistance could be found from companies available on the market.

4.8 Final recommendations

A number of research infrastructures seem to have been put on the Roadmap and entered the Preparatory Phase before concept/project screening had come to a final conclusion. Member States, the European Commission and ESFRI may want to consider

stage-gate type reviews before including the research infrastructure on the Roadmap and later to confirm or otherwise the continued position of projects on the Roadmap.

An independent managerial and financial review, taking into account the risk analysis, could also benefit the research infrastructures on the Roadmap that have been excluded from the present assessment. A positive result of such reviews would be useful in boosting confidence that a project implementation phase would be successful in cost, schedule and performance.

As it is not clear that the funding is available in Europe to fully implement all of the research infrastructures on the Roadmap, it may not always be appropriate to have a Preparatory Phase that expects all projects to reach implementation. This phase should be an occasion for screening projects and selecting those which should be further implemented.

Several of the distributed research infrastructures on the Roadmap look more like worthy networks of important national facilities instead of than a true European research infrastructure. A different assessment and support mechanism for networks and research infrastructures should be considered. These already exist, but the current situation is that some projects on the Roadmap have constrained themselves to try to look like a research infrastructure when in reality they are networks of existing or planned national facilities.

In many cases the central hub of distributed research infrastructures, that should reflect the European added value, has very little or no control or influence over the national investments and the initial activity plan is just the sum of the ongoing, largely independent national activity plans. Strengthening of the central hubs of distributed research infrastructures in relation to the national nodes is recommended in order to allow them to operate as a single European research infrastructure. This is likely to require additional national and European resources, but above all a willingness to give up some measure of national independence to optimise the use of European resources.

Some of the difficulties in strengthening the coordination and increasing the European added value of research infrastructures derive from the fact that too often institutions and research infrastructures believe that they should compete for a fixed number of users. It should be made clear that European research infrastructures should instead have the common goal of extending their services to the many users that could benefit from them and that are currently not using them, i.e. expanding the size and quality of the overall European user base.

Coordinated use of structural funds is an important potential tool, but the current limitations of this instrument that tends to cover only investment costs and can only be used on a national basis, hinder its effective use for developing European research infrastructures. There should be concerted efforts to adapt financial and procurement rules in the use of different funds (Horizon 2020, ERDF and national funds) to the very different reality of European research infrastructures as compared to conventional infrastructures, and help ensuring cost coverage also for operational costs, notably in convergence areas.

Many research infrastructures would benefit from expert support and mentoring. This is particularly true in the early stages, when basic lessons learned and best practice from other projects could be introduced. For the research infrastructures on the Roadmap to succeed, this support needs to be in place. Mechanisms for cross-fertilisation should also include inviting members of the industrial and funding community in the research infra-

structure boards, as well as promoting exchanges of staff across the different research infrastructures.

The development and training of international managers and executive Directors for research infrastructures remains probable key issue for ensuring success. Conferences and meetings are occasions to share best practices, but a stronger mechanism to disseminate success stories is to allow capable managers with good track record also in industrial and commercial fields to move from one research infrastructure to another, or to set international task forces with experts in procurement, financial planning, user management, governance, risk and project management.

ANNEXES

ANNEX 1. Terms of Reference of the Assessment Expert Group

Terms of Reference for the Expert Group on Assessment of the ESFRI Roadmap Projects

INTRODUCTION

- Research Infrastructures are a key component of the European Research Area (ERA). They bring together a wide variety of stakeholders to search for solutions to the scientific problems being faced by society today, they offer unique research opportunities to users from different countries and from different disciplines, attract young scientists and help to shape scientific communities, and they play an increasingly important role in the advancement of knowledge and the development of technology to help Europe compete in an increasingly globalised knowledge economy.
- The ESFRI Roadmap for Research Infrastructures, published in 2006 and updated in 2008 and 2010, is a vital policy document and paves the way for the planning, implementation and upgrading of research infrastructures for the coming decades. Research Infrastructures contribute to making the Europe 2020 Strategy and its Innovation Union Flagship Initiative ([10]) a reality. Moreover, Research Infrastructures should help to

10 Council conclusions of 26 Nov. 2010 on Europe 2020 flagship initiative 'Innovation Union'.

realise the potential of the regions, to increase international cooperation and continue their opening to, and partnership with, industrial researchers to help address societal challenges as well as to support EU competitiveness.

- To date, 48 facilities have been identified to be of pan-European (or global) relevance. Of these, 10 have been considered 'under implementation' in the 2010 ESFRI Strategy Report and Roadmap update, and another 16 are likely to start their implementation by the end of 2012.

OBJECTIVES

- Implementation of the project on the ESFRI Roadmap is now a priority for ESFRI and the European Commission in order to fulfil the commitment of the Innovation Union Flagship Initiative that, 'By 2015, Member States together with the Commission should have completed or launched the construction of 60 % of the priority European Research Infrastructures currently identified by the European Strategy Forum for Research Infrastructures.'

IMPLEMENTATION

- In order to assess progress towards the Innovation Union objective of launching or completing the construction of 60 % of the ESFRI projects by 2015 and to assess the type and level of EU support which could be dedicated to the ESFRI projects under Horizon 2020 the European Commission (EC), together with ESFRI, has decided to set up a high-level Expert Group.
- The primary objective of this group is not to assess the scientific merits of the projects, but to evaluate the financial and managerial maturity of the projects of the ESFRI Roadmap.
- The Assessment Expert Group will not analyse in detail the ten projects highlighted as success cases and 'in the implementation phase' in the 2010 roadmap. Additionally, the projects under the direct control of ESO, CERN and those in the framework of the Euratom Treaty will not be considered either since these organisations are entirely responsible for their development and construction. Nevertheless, these might be subject to a subsequent separate assessment.
- The report on each individual project should clearly identify specific bottlenecks and make recommendations on how to best address them and indicate the feasibility for these projects to be implemented by 2015.
- Furthermore, the Expert Group should suggest further actions (e.g. clustering) to reinforce the coherence and synergy amongst the projects.
- The assessment should follow common rules for all projects to guarantee an impartial process and allow projects to be compared. In particular, for each project the Expert Group should concentrate on the assessment of the current situation and appropriate progress in areas such as:
  - Appropriateness of the partners' contribution towards the realisation of the facility (including technical, managerial, leadership or siting issues);
  - Soundness, appropriateness and effectiveness of the financial commitments of the partners, including national and regional funding, funding from the EC structural funds and from Horizon 2020, as well as possible private funding;
  - Existence of appropriate management, governance and legal structures (are statutes already available even in draft state and accepted by funding agencies and ministries?);
  - Availability of a technical design report (if appropriate) or other necessary technical documentation;
  - Schedule for construction and operation (and decommissioning where relevant);

- The policy for open access to the facility and to data (which does not necessarily mean free access), as well as for data management, storage and dissemination;
- The IPR policy.

- If projects have changed considerably from the scientific point of view since their original proposal, or the landscape has changed, this should also be taken into account.

DELIVERABLES

- The Expert Group will deliver a written report on the state of implementation and recommendations for the assessed projects.

WORKING APPROACH

- The Expert Group will work mainly by e-mail and through meetings, teleconferences and videoconferences, as preferable.
- The Expert Group will carry out its evaluation exercise based on the available documentation, by interviewing the project coordinators, project partners and EC staff following the projects. In particular for obtaining up-to-date information on the foreseen level of funding they should refer directly to ESFRI Members and/or the Implementation Group.
- Requests for data and information will be made through the Secretariat.
- One member of the Expert Group shall act as Rapporteur.
- The Expert Group will regularly inform the EC and ESFRI of progress in the conduct of its business, and when appropriate, will request direction and guidance.
- The Expert Group will present a preliminary report to ESFRI and the EC by the time of the ESFRI meeting of December 2012. The report should be finalised with a view to be published by spring 2013.

MEMBERSHIP

- Members of the Expert Group will be high-level people with relevant experience in managerial and administration aspects of setting up large-scale research infrastructures, and in particular user-orientated facilities.
- There will be up to seven members of the Expert Group. The Chair will be chosen from these.
- The Chair of the ESFRI Implementation Group will be an Adjunct Member ([11]) of the Expert Group. He will act as liaison between the Expert Group and both ESFRI and the Strategic Working Groups.
- The member(s) of the EC Secretariat will be additional Adjunct Member(s).

CONFLICT OF INTEREST

- No member of the Expert Group shall be directly involved with any of the research infrastructures on the ESFRI Roadmap.
- Any further potential conflict of interest should be declared or identified immediately by candidate Expert Group Members. Any candidate Expert Group member with a conflict of interest may not be an Expert Group Member. If a serving Member identifies or develops a conflict of interest, it will be at the discretion of the Chair and remaining members to decide its gravity and if that Member should be replaced.

11 An Adjunct Member participates in all Expert Group activities and provides advice to, and assists, the Expert Group in its deliberations, but does not have a say in reaching the final recommendations.

ANNEX 2. AEG Questionnaire template

Introduction

The European Commission has appointed a group of experts with diverse professional experience to assess the maturity of the research infrastructures on the ESFRI roadmap. The group is composed of reputed professionals in the field of research, listed hereafter in alphabetic order: Professor Alfonso Franciosi (University of Trieste and CEO Elettra-Sincrotrone Trieste), Professor Sine Larsen (University of Copenhagen), Dr John Marks (former Deputy CEO, European Science Foundation), Dr Karl Tichmann (former Managing Director, Max Planck Institute for Plasma Physics, IPP), Professor Richard Wade (former Chief Operating Officer, Science and Technology Facilities Council, STFC) and Professor Milena Zic Fuchs (University of Zagreb). Dr Antonella Calvia-Goetz, an expert on Research Infrastructures appraisal at the European Investment Bank, chairs the group.

Contact points for the European Commission: Elena Righi-Steele and Paul Tuinder.

Legal notice:

All experts act on a personal basis. The work of the Assessment Expert Group does not engage in any way any of their institutions (including the European Investment Bank).

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Letter

Dear Project Coordinator,

The European Commission has tasked the Assessment Expert Group with reviewing the maturity of the projects included in the ESFRI Roadmap. Its goal is to assess the current project status and the likelihood of each project entering the implementation phase by 2015.

To this end, the Assessment Expert Group needs updated written information and, where possible, documentation about each project (see the reference list of additional documents in Section 7 below).

To assess the maturity of the projects the Expert Group will examine the following general areas: Costs and Financial Commitment, Governance, Scientific and Legal Management, Human Resource Policy and Project Management, R & D and Innovation Policy and Engagement with Stakeholders, User Strategy, Feasibility and Risk.

We kindly ask you to reply to the best of your ability to the enclosed questionnaire (Sections 1 to 6) and to provide, whenever possible, existing accompanying documentation (Section 7). If you think that a specific question does not apply to your facility, please indicate this explicitly and indicate why not. Please also provide an updated short summary description of your research infrastructure, as per Table 1.

Your replies will form the basis for the assessment of your project by the experts. If further clarifications are needed, interviews will be organised between January and March 2013.

Kindly send the answers to the enclosed questionnaire at the e-mail address indicated in the accompanying email by 15 December 2012 and any relevant and already available written documentation about your project. Please base yourselves on currently existing documentation, since the current assessment exercise is focused on the progress achieved until now.

Yours
The Assessment Expert Group

List of questions:

For distributed research infrastructures consider only the Coordinating/Central Entity.

Costs and Financial Commitments

- Describe the top-level cost structure including construction and operations. If there are decommissioning costs, have these been identified?
- Provide current cost estimates and budget projections (with the currently available breakdown). Please indicate the confidence levels of your estimates. Please indicate if they are based on suppliers' quotations.
- Describe the current level of financial commitment to the project. Please provide relevant supporting documents.

Governance, Scientific and Legal Management

- What is the chosen legal structure? Please enclose statutes and related documents.
- Please explain how the roles of the Chair, Director, Boards, etc. are defined to ensure good governance and control. Please provide an organisation chart relating to governance.
- What, in your view, is the added value of performing the research activities foreseen within a research infrastructure instead of performing it as a research programme in consortia, cooperation etc.?

HR Policy and Project Management

- Describe the plans or established procedures for project manager selection, staff hiring and independent project evaluation.
- Describe the parameters to gauge project success (KPIs), planned project work breakdown structure (WBS) and related responsibilities, major item procurement schedule, coordination methods within the project and among the partners and a timeline with milestones. Provide the conceptual design report (CDR), if applicable.
- Describe the internal project organisation and reporting structure.

R & D Policy and Engagement with Stakeholders

- Who are your stakeholders (government ministries, research funding organisations, EC, private sector and public bodies, scientific community)?
- What is the nature of their commitment, including any in-kind contributions?
- In what form (documents) is the commitment expressed?

User Strategy

- Describe the size and composition of the expected user community, including the relative distribution between users from academia, research institutions and commercial entities. Please describe the envisioned access policy to the infrastructure for the different groups of the user community. Please address any ethical issue connected with user access.
- Describe the data-access policy and any implication it may have for Intellectual Property Rights.
- Describe in detail the 'pricing' policy for international user access, relationships with industry, commercial exploitation of IP and/or services available.
- Describe the procedure for appointing international review and advisory panels that will regulate access by non-commercial users and the industrial liaison organisation that will regulate access by commercial users, if applicable.

Feasibility and Risks

- Are there scientific developments elsewhere that could affect the research foreseen at the infrastructure?
- Please give us a list of risks that, in your view, could delay, increase the cost of or make realisation of the infrastructure tasks impossible. Have you undertaken a technical options analysis?
- What are the main schedule uncertainties? Do you have any specific technical risks?

Additional Documents

- Final infrastructure proposal, including, if available, Feasibility Study, Investment Review and Legal Statute.
- Organisational and schedule charts.
- The next steps and the five most important milestones until construction/operation start, including the milestones to be reached by mid-2015.
- The five most important problems to be solved before start of construction/operation.
- The five most important milestones in the first two years after construction/operation start.

Table: Summary of Research Infrastructure

Name of the Project:			
Description:			
Please add a Photo	**Year of introduction in ESFRI Roadmap**	**Expected Year for Implementation**	**Expected Year for Starting Operation**
Legal Structure	**Scientific Goals**	**Expected Socio-Economic Benefits**	**Type of Infrastructure**
			Distributed RI Or Single-Site
Host Country/ Key coordinator	**Partner Countries**	**Key Stakeholders**	**Key Users**
Estimated Project Investment Cost (years) ([12])	**Annual Project Operational Cost ([13])**	**Overall Annual Contribution ([14])**	**Overall In-Kind Contributions ([15])**

12 Please indicate your key assumptions in a footnote or in an Annex.

13 Ditto as 2.

14 Ditto as 2.

15 Ditto as 2.

ANNEX 3. Assessment Matrix

		SH	EXPECTED REQUIREMENTS — STAKEHOLDER ENGAGEMENT AND FINANCIAL COMMITMENTS
Preparatory Phase	Concept Screening	1	• Encouragement of the initiative.
		2	• Co-funding of the definition study.
		5	• Define the concept and scientific and societal benefits. • In kind contribution to the definition study.
	Feasibility Study	1	• Co-funding of the Feasibility Study.
		3	• Funding of the Feasibility Study.
		4	• Expressions of interest in contributing to the construction and/or use.
		5	• Leading the Feasibility Study and engagement of the wider user community.
Approval Phase	Business Case Review/ Delivery Strategy	1	• Inclusion on National Roadmaps.
		2	• Conditional intention to co-fund construction and access.
		3	• Inclusion on the ESFRI Roadmap.
		5	• User community identified. • Commitment core institutes secured.
	Investment Decision	1	• Approval of tender and commitment to fund construction.
		2	• Approval of tender and commitment to fund construction.
		3	• Legal entity approved.
		4	• Interest in responding to the tender.
		5	• National nodes willing to commit to a central (ERIC) node (distributed research infrastructure). • Commitment to invest in kind resources in the construction.
Implementation Phase	Construction	1	• Funding of the construction.
		2	• Contributing to the funding of the construction.
		4	• Public-private arrangements in the construction.
		5	• Participation in the construction through in kind contributions.
	Operations	1	• Long Term funding for operations.
		2	• Long Term co-funding for operations; access funding.
		3	• Access funding and use in EU policies.
		4	• Utilisation of the research infrastructure.
		5	• Substantial frontier research results. • Open access and IPR policies. • Embedding in international research programmes. • Institutional Long Term commitments and payment of access fees.

Stakeholder List

1. Governments (political and financial)
2. Research funding agencies
3. EC (policy support and funding)
4. Private sector (provider and user)
5. Scientific community

		EXPECTED REQUIREMENTS — COSTS AND FINANCIAL STRUCTURE
Preparatory Phase	Concept Screening	• Top-level breakdown of cost elements with overall order of magnitude estimates.
		• Outline of funding concept and potential partners (e.g. nature of partnership, in-kind vs. cash contributions).
	Feasibility Study	• Detailed cost structure developed with all cost categories defined and approved by shareholders.
		• Estimates and confidence levels available for each element.
		• Accounting principles agreed with shareholders.
		• Option analysis is undertaken to establish project on funder's roadmap with appropriate timing. Identification of funding opportunities.
Approval Phase	Business Case Review	• Cost refinement based on supplier discussions. Accounting and budget system in place to track use or resources. Identification of major sources of Funds, including Structural Funds.
		• R&D investment in place for critical technologies.
		• Major financial risks identified and addressed.
		• Accounting and budget system in place to track use or resources.
		• Letters of interest or MoUs in place with potential funding partners. Clear contribution mechanisms in place.
	Delivery Strategy	• Firm costs based on supplier discussions or quotes. Critical technology issues resolved. Auditing of accounting and budget systems.
		• Financial risk management and contingency policies in place. Auditing of accounting and budget systems agreed.
		• Auditing of accounting and budget systems.
		• Final cost tables submitted to decisional making bodies.
		• All budget requests and investments covered by identified financial instruments.
	Investment Decision	• Procurement strategy ready for final disbursements.
		• Financial reporting set up.
		• Work-packages and in-kind contributions fully detailed and centrally budgeted.
		• Funding partnership in place with firm commitments for construction and operation.
Implementation Phase	Construction/ Operations	• Financial risk management change control in place.
		• Reporting mechanism agreed and in place. • Auditing of accounting and budget systems.

		EXPECTED REQUIREMENTS — HR POLICY AND PROJECT MANAGEMENT
Preparatory Phase	Concept Screening	• Existence of a credible and timely staffing plan, likelihood of implementing a qualified project management and a clear reporting structure.
	Feasibility Study	• Likelihood of implementing a credible project organization, with clearly defined responsibilities and reporting lines, measurable and credible Key Performance Indicators.
Approval Phase	Business Case Review	• Existence of a credible project budget control system, likelihood of controlling the cost of project changes, procuring major project items on schedule, implementing the staffing plans envisioned.
	Delivery Strategy	• Existence of a credible project organization targeted to implementing procurement and staffing with minimum risk of cost overruns and litigations.
		• Existence of a procurement strategy clearly identified and a procurement task force in place.
	Investment Decision	• Performance of a credible independent (external) review/audit of project costs and of the project technical and/or scientific implementation plans. Key positions for implementation filled.
Implementation Phase	Construction/ Operations	• Existence of a qualified project management with sufficient independence and powers and an adequate project implementation structure. • Existence of a viable organization for long-term operations, adequate staffing and independent monitoring.

		EXPECTED REQUIREMENTS — GOVERNANCE AND LEGAL STRUCTURE
Preparatory Phase	Concept Screening	• Founding Agreement and MoU
	Feasibility Study	• Supervisory Board and other Advisory Boards (e.g. Ethical Board) responsibilities outlined.
Approval Phase	Business Case Review	• Legal option analysis and negotiation of best governance structure.
	Delivery Strategy	• Planning in detail available for all the years of construction until entering into operation.
		• A definitive legal option selected and next steps for legal entity fully agreed by stakeholders.
	Investment Decision	• Legal entity approved with all decision making mechanisms in place, including Audit, voting rights, and appointment process.
		• Role of the Chair, Director and Deputies clearly established. Balance and Check mechanisms adequately established.
		• Advisory Board role and mechanism for appointment defined.
		• Financial Committee and Budget structure and responsibilities defined. Safeguard mechanisms for good governance established.
		• Key Performance Indicators for management established. • Ethical Committee appointed.
Implementation Phase	Construction/ Operations	• List of the names of the key managers already appointed. • Description of mechanisms for dealing with non-performing managers.

		EXPECTED REQUIREMENTS — USER STRATEGY
Preparatory Phase	Concept Screening	• Survey of the expected user community describing it in terms of origin and size.
	Feasibility Study	• Existence of a proposition for the envisioned access policy for the different groups of user community including a strategy for possible commercial exploitation. This requirement must be fulfilled for all infrastructures encompassing both those with unlimited access and those with limited access.
Approval Phase	Business Case Review	• Existence of a proposition for the data access policy and the way IPR questions will be handled.
	Delivery Strategy	• Through an analysis of the Key Performance Indicator identify the likelihood to achieve reasonable impact on the national and international user community and on industry, when applicable. Identification of private and public demands.
		• Definition of Key Performance Indicators for international users. Existence of a protocol for data handling and proposition of its location.
	Investment Decision	• Analysis of the possibilities to develop a reasonably sized user community, considering the costs and services based on a clear identification of demands and needs: User Strategy
		• Establishment of a pricing policy for users' access or and quality assurance.
		• Existence of an organizational structure with a procedure for regulating user access. Peer reviews should be employed wherever appropriate.
		• Existence of a sufficient concern for international screening of facility operations. National Coordinators to disseminate knowledge of the standards and protocols for user access.
Implementation Phase	Construction/ Operations	• Engagement of users in the initial start-up phase avoiding competition between internal and external users. • Probability of the growth of viable user community with long-term relations with the facility. Existence of an adequate output of publications from the facility. Through interactions with commercial partners quantification of potential cost coverage opportunities and contracts.

ANNEX 4. Acronyms

AEG	Assessment Expert Group
AISBL	Association internationale sans but lucratif
BBSRC	Biotechnology and Biological Sciences Research Council
BMBF	Bundesministerium für Bildung und Forschung (German Federal Ministry of Education and Research)
CEA	French Commissariat à l'Energie Atomique et aux Energies Alternatives
CEO	Chief Executive Officer
DG REGIO	Directorate-General for Regional and Urban Policy
DTU	Danmarks Tekniske Universitet
EBI	European Bioinformatics Institute
EC	European Commission
EIB	European Investment Bank
EMBL	European Molecular Biology Laboratory
ERA	European Research Area
ERDF	European Regional Development Fund
ERIC	European Research Infrastructure Consortium
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EUSF	European Science Foundation
FP6	6th Framework Programme
FP7	7th Framework Programme
FTE	Full Time Equivalents
GmbH	Gesellschaft mit beschränker Haftung
HO	Head Office
HR	Human Resources
HQ	Head Quarter
ICT	Information and Communications Technology
IPP	Max Planck Institute for Plasma Physics
IPR	Intellectual Property Right
KPI	Key Performance Indicator
LIFE	Laser Inertial Fusion Energy
LMJ	Laser Mégajoule (LMJ) Facility
MoU	Memorandum of Understanding
NERC	National Environment Research Council
NIF	National Ignition Facility
NWO	Nederlandse Organisatie voor Wetenschappelijk Onderzoek
R & D	Research and Development
SAB	Science Advisory Board
SEAB	Scientific and Ethical Advisory Board
STFC	Science and Technology Facilities Council
ToR	Terms of Reference
VCC	Virtual Competency Centre
WBS	Work Breakdown Structure

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The implementation of the European facilities on the roadmap of the European Strategy Forum for Research Infrastructures (ESFRI) is critical for the EU to remain at the forefront of science and technology and be competitive in a global knowledge-based economy. That is why the EU has set itself the target of implementing at least 60% of the ESFRI roadmap by 2015 through its Innovation Union flagship initiative.

This process should be accompanied by sound assessment of the progress that projects have made since they were put on the ESFRI roadmap. A high level expert group conducted an in-depth analysis of all the non-scientific aspects of the projects. The report identifies open issues and bottlenecks that are currently delaying the implementation of the ESFRI roadmap projects and assess whether the facilities are likely to be implemented by 2015. The report also offers detailed recommendations on how to overcome obstacles and difficulties. A lot of work still remains to be done by the projects, the stakeholders, the Member States and the European Commission to ensure that the European infrastructures are operational.

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