ANALYTICAL RESEARCH INFRASTRUCTURES IN EUROPE

CHALLENGES AND OPPORTUNITIES
JOINT POSITION PAPER

ARIE

arie-eu.org

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BACKGROUND

Analytical Research Infrastructures in Europe (ARIE) is a consortium of seven Research Infrastructure (RI) consortia:

- e-DREAM (electron microscopes)
- EMFL (high magnetic fields)
- Inspire (proton beam therapy)
- Laserlab Europe (lasers)
- LEAPS (accelerator-based photon sources)
- LENS (neutron sources)
- RADIATE (ion beams)

ARIE RIs range from distributed collections of individual scientific instruments located in universities and institutes (e.g. electron microscopes), to large single-site international research facilities (e.g. the ESRF synchrotron).

In total, ARIE represents over 100 different RIs that support the work of more than 40,000 researchers from academia and industry across a range of domains: the physical sciences, energy, engineering, the environment and the earth sciences, as well as medicine, health, food and cultural heritage. They are a core part of the European Research Area.

STAKEHOLDERS

ARIE RIs are user facilities, with most use being open and free (to the user) at the point of access. Some of them have been serving external users for over five decades, and participating in EU Research Infrastructure programmes since these started in the early 1990's; some are more recent. There are four international RIs, e.g. owned by more than one country. All are ESFRI landmarks, as is the EMFL consortium, and one is a European Research Infrastructure Consortium (ERIC). However, the vast majority of ARIE RIs are national, e.g. owned by a single country. For the national RIs, although there is some international use, i.e. from outside Europe (<20%), most users are national (>50%) or transnational, i.e. from within Europe (25-50%). The higher levels of transnational access tend to be at the larger RIs, e.g. those within LEAPS and LENS.

ARIE RI users come from hundreds of different universities, research institutes and industries. The RIs support thousands of individual research projects and provide unique training opportunities for thousands of students. Their user communities are far from static; there is a steady turnover of students and postdocs, as would be expected, but also of Principle Investigators.

A high proportion of the research carried out at ARIE RIs is in priority theme areas such as energy, environment, health and digital economy. Almost all facility users require funding to carry out their research programmes, so a lot of this research will be in areas that are prioritised by national and EU programmes. This is then naturally reflected in RI use, rather than a result of directed or prioritised programmes at the RI. Because it may take a number of years to design and build new instrumentation, successful RIs need to plan ahead and incrementally develop their capabilities and access mechanisms to be able to seamlessly respond to changes in external priorities. However, externally it may then appear that they are not responding.

ARIE RIs have a significant economic and societal impact, both locally and nationally (see e.g. a study for the Diamond Light Source).

FUNDING

Most funding for ARIE RIs, even for those that are international, comes from national research programmes; EU RI funding is only a few % of the total. The individual budgets of the larger RIs are over 100M€ per year and they can each represent an integrated capital investment (asset) of over 1B€. The smaller RIs have budgets of a few M€ per year and represent a correspondingly smaller capital investment.

For the larger ARIE RIs, the marginal costs of operation are typically low (20%) compared to the fixed costs (80%); for example, staff costs alone can be 50% of the budget. This means that small changes in funding can lead to large changes in operating time, and hence research output. Some ARIE consortia, such as e-DREAM, are only able to operate as open user facilities through EU funding, which supports the marginal costs. For both large and small RIs, long term stability of funding is therefore as important as the scale of funding.

CHALLENGES

FRAGMENTATION

EU RI funding started with a small number of individual co-funded projects in the second Framework Programme, FP2. The number of separate projects, including organised collaborations ('Round Tables'), increased through FP3-FP5 leading to the large Integrated Infrastructure Initiatives (I3) in FP6. EU Transnational Access (TNA) programmes – both as individual projects and within the Integrated Infrastructure Initiatives - were transformative in lowering the barriers to transnational research collaboration and broadening RI use to countries without relevant national RIs. Although EU funding was a small % of the total, the collaboration structures that the I3s provided were extremely effective and formed the foundation for the individual ARIE consortia - and hence for ARIE as the umbrella consortium. However, through FP6 and FP7 the degree of RI integration enabled by EU programmes has gradually decreased.

In Horizon Europe RI, activities are spread across many potential projects, each with many partners. While the focus on priority themes is understandable, this is not an efficient way to achieve the desired outcomes. The participation of individual RIs in these projects is fragmented and marginal, with similar activities repeated, and yet without the certainty of enough integrated funding across multiple projects to enable the quality of coherent support that is required. The incentive to participate is rapidly decreasing, with the risk that EU programmes then lose the capabilities, and corresponding benefits, provided by core parts of the RI landscape.

DISTRIBUTED RIs

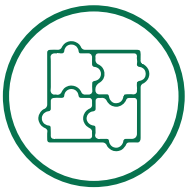
The concept of Research Infrastructures has expanded considerably over the last 30 years, originally starting with large single-sited infrastructures, but now including many examples of distributed collections of similar instrumentation, or even diverse instrumentation, with a common scientific theme. This distributed instrumentation naturally has different owners (e.g. universities), and mainly it exists for the 'private' purposes of those owners, but often there is potential spare capacity that can be enabled by a relatively small amount of additional (marginal cost) funding. Past EU TNA programmes have been very successful in unlocking this capacity and making it available for wider European benefit. However, if EU funding is not available then it is not normally within the remit of either the instrumentation owners, or of national funding agencies, to replace it. A number of successful RIs, that the EU has actively created, will therefore simply disappear.

RESEARCH SERVICES

Current Horizon Europe programmes place an emphasis on RIs providing 'services'. This is appropriate for 'measurements' but not for 'research'. ARIE RIs do some of the former, for example highly automated protein crystallography at synchrotrons,

but they mainly do the latter and that is where their main value/impact lies for both academia and industry. Real 'research services' are expensive, since they need the dedicated support of experts for individual research projects.

Indeed, one of the reasons that Europe has been so successful with its RIs is that many have embraced the 'user facility' concept, and some were its early developers. Successful user facilities do not just provide access to technically supported and maintained instrumentation, e.g. as might be done for a high performance computer, they also provide opportunities for expert people (users) to work with expert people (facility scientists), and to connect users with other users. Although user facilities will often talk of providing user services, many of these services are in effect highly individualised and cannot easily be scaled up to cope with the demands of short term projects.



INTEGRATION

EU-funded RI projects often emphasise the objective to achieve a higher degree of integration, for example through the development of common access portals. This makes sense for new consortia of distributed individual instruments. However, for large RIs that may individually operate tens of instruments for thousands of users, the access portals are already highly developed and connected to their operational management systems. Since many ARIE RIs have been collaborating for years, many of the opportunities for effective commonality or integration have already been exploited.

FUNDING IMBALANCE

As the proportion of transnational open access has increased, which has been noted as a success of EU TNA programmes, the imbalance between those countries using a particular RI and those funding it has increased. It is general practice for international RIs that the proportion of use mainly relates to the proportion of funding from member countries, but for national RIs this is increasingly not the case. For countries that operate a range of national RIs, unmanaged mutual exchange of access with other countries can avoid unnecessary duplication of capabilities and may be reasonably equitable from a financial perspective. However, some countries benefit from free access to other national RIs and even rely on this implicitly in their membership of international RIs. There is of course a benefit to national RIs from unfunded open access, since it provides collaboration opportunities between national and transnational researchers. However, this is only valid to a certain extent, because given a fixed RI capacity (normally determined by net funding), the transnational use is also taking opportunities away from other national researchers.

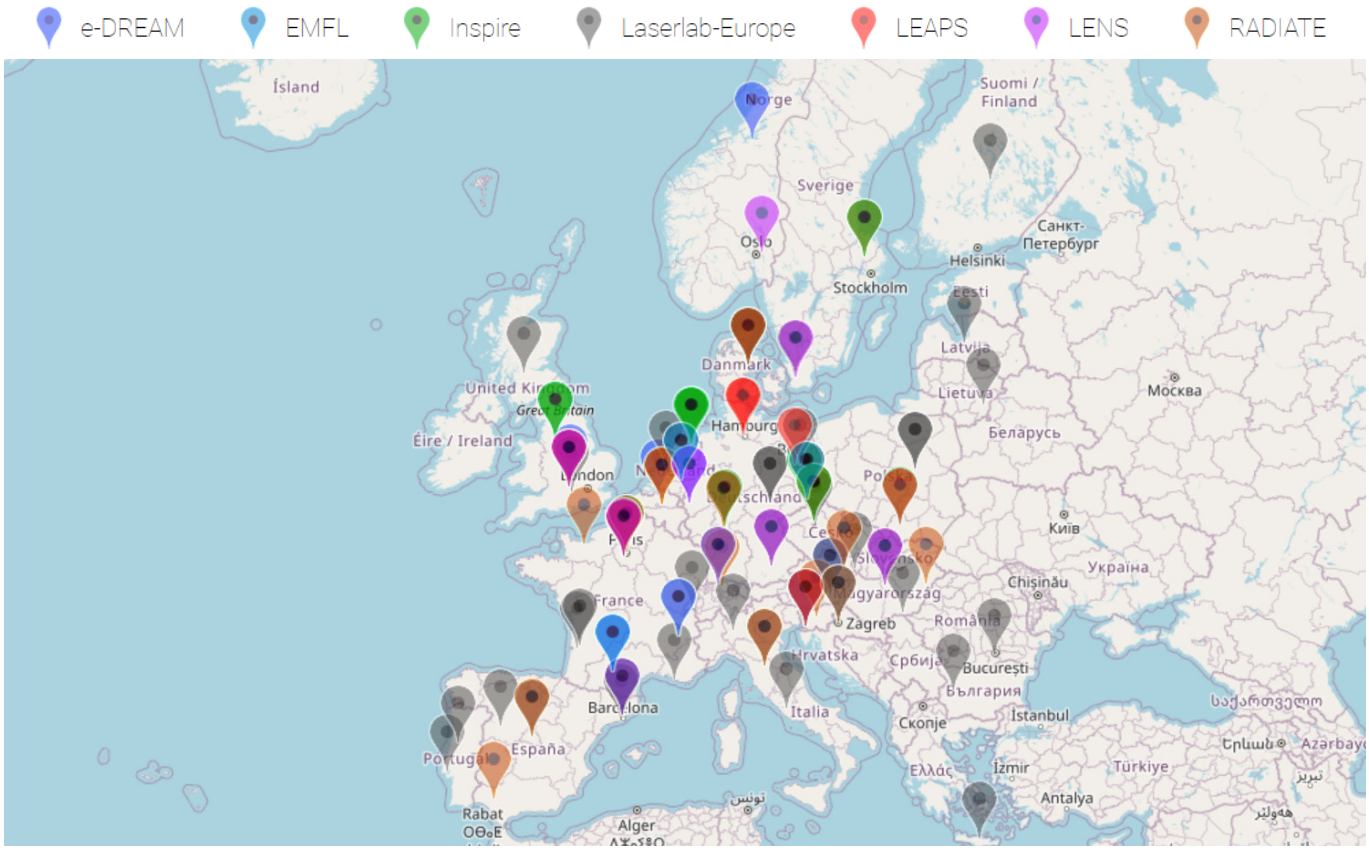
In some circumstances, for example where net capacity across a particular type of RI is increasing, e.g. as currently for LEAPS RIs, such imbalances may be acceptable. In other cases, e.g. for LENS RIs where a number of national RI have closed in recent years, they can lead to instability in the ecosystem.

OPPORTUNITIES

ARIE has an enormous wealth of experience in effective RI operation and the provision of services to a wide range of users. This expertise should be used more effectively in the development of strategies and programmes at the national and European level.

ESFRI landmarks are only a few % of the RIs within ARIE, and their success is intrinsically dependent on the broader ecosystems of national RIs in which they operate. ESFRI landscape analyses recognise this dependency and provide an overview, but miss the detailed understanding of the ecosystems that is needed to ensure their long term stability. There is a need to understand who uses all RIs and who funds them, both in terms of particular ecosystems of RIs and in terms of individual countries, and including short and long term expectations and strategies.

The 'I3 Network', a collaboration of Integrated Infrastructure Initiatives in FP6 with some similarities to ARIE, developed the concept of 'vertical' and 'horizontal' I3 to address how to support effective RI collaboration at the same time as prioritising services for particular research themes. 'Vertical' I3 (as in FP6) provided the funding for I3 consortia to undertake technical collaboration and other integrating activities, at the same time as supporting a scale of TNA. Themed 'horizontal' I3 would then involve RI from a range of I3 as required, drawing on the (already funded) capabilities provided by the 'vertical' I3, to address thematic priorities. They would only require supplemental funding for the theme specific aspects, and would include other actors as necessary. The current programmes in Horizon Europe are in effect 'horizontal' only and lack the effective use of resources and structural stability provided by the 'vertical' projects.



The ARIE network comprises more than 100 European RIs.

ARIE MEMBERS

European Distributed REsearch Infrastructure for Advanced Electron Microscopy (e-DREAM)

e-dream-eu.org

European Magnetic Field Laboratory (EMFL)

www.emfl.eu

Infrastructure in Proton International Research (INSPIRE)

www.protonsinspire.eu

LaserLab-Europe

www.laserlab-europe.eu

League of European Accelerator based Photon Sources (LEAPS)

www.leaps-initiative.eu

League of Advanced European Neutron Sources (LENS)

www.lens-initiative.org

Research and Development with Ion Beams – Advancing Technology in Europe (RADIATE)

www.ionbeamcenters.eu

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