

Recommendations for Research Infrastructure policy in Lithuania

Foreword

The international Panel on Lithuanian Research Infrastructure discussed throughout its deliberations various aspects of handling the task on funding national research infrastructure in small countries. The Panel also devoted a final session to systematically discuss various aspects of this problem. In the present document, the essence of the ideas discussed were summarized and extended with some further ideas by the Panel Chair, Gabor B. Makara.

Research infrastructures

A research infrastructure (RI) in general refers to structures, systems, and facilities serving a country, city, area or a research institution, including all the services and facilities necessary (or essential) to enable, sustain, or enhance its research to function. In contrast, it is the research instrumentation which is needed for a program or institution to carry out its particular type of research. Thus, the infrastructure is by definition is used by a number of researchers in the broad area served by the infrastructure.

Defining the national infrastructure

The term National Research Infrastructure (NRI) is used in this document to label *unique* research infrastructures which are of national and possibly international importance and because of its size and cost requires national level considerations.

Research Infrastructures are *unique facilities, resources or services* that are required for top-level activities in any given field or set of fields. The concept spans the whole range of science and technology, ranging from the Social Sciences and Humanities to Physical Sciences and Engineering. They include distributed Research Infrastructures as well as single sited ones, even virtual infrastructures delivered as electronic services (based on the ESFRI roadmap). Examples are a large telescope, a set of powerful lasers, a supercomputing facility or an important national research database.

Because of the wide scope of the concept there is no single comprehensive set of characteristics which are all required for identifying a given NRI. However, a number of characteristics together form a conceptual framework where any NRI should have the majority of the characteristics.

Some of the key characteristics of the NRI are as follows.

- NRI allows to carry out high level of research comparable to the best international research in the discipline;
 - NRI is of national importance and contributes to achieving the Smart Specialization and other national research and innovation goals;
 - NRI has high added value to the scientific, economic and social impact in the country.
 - The NRI should serve a critical mass of experienced researchers working on international arena in the discipline.
 - NRI host (institution, division or particular group) carries out high-level research comparable with the best work internationally in the discipline.
 - Institution or division ensures an environment that is fully comparable to the international institutions in the discipline, in terms of the organization, strategy and infrastructure of research.
 - Capability of attracting students in general, PhD students and highly competent researchers.
 - The NRI's investment and operational costs are within the available financial resources of the country and its scientific institutions.
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- NRI project costs are feasible, funding sources are diversified and the plan for the usage and future maintenance of NRI is realistic;
- NRI is based on the open access principle, for the scientists, the public and private sector researchers on national and international level.
- NRI compliance with EU research infrastructure policy.

Some of the NRI may also serve directly the broader society.

For selecting and ranking proposals some considerations are more important than others.

- National importance, uniqueness and Open Access cannot be replaced by other considerations.
- Sizeable demand; sufficient number of users
(demand by excellent researchers should be considered together with verified demands by other stakeholders, such as students, professionals and in some cases even lay members of the society).
- Capacity should match demand.
- Excellence is the main criteria, without excellent users the infrastructure should not be called NRI.
- Budget carefully planned and detailed.
- Cost-benefit analysis should show that the proposed research activity cannot be better facilitated by institutional investment or by joining an international RI
- Long-term operation should be sustainable.

Budget considerations

A practical aspect of the call for proposals is that a minimum and maximum budget limit may orient the prospective applicants. Anything which can be obtained and operated in an economical way in an institutional setting is by definition not a NRI and should be excluded. Anything which is beyond the budget available should also be excluded. The minimum budget limit may be different for different branches of sciences, for example the budget for the humanities and social sciences NRI may be between 0.5 to 2 million Euros while in the sciences a range of 2 to 5 million may be appropriate.

Smaller investments should be handled by an institutional infrastructure program or in a valley cluster even when it is for joint use with other institutions.

Small countries – special considerations

- A small country should be more selective in investing in research infrastructure. Stronger focus in selecting the research priorities/topics. Importance for the country and the number of excellent prospective users should be given considerable weight. Benchmarking with other countries should be made in order to find niches. Opportunities should be explored to jointly use (and finance) existing RI in other countries which may be within acceptable distance. Decision to create NRI or to join European RI should be made after benchmarking.
 - Lithuania has an established policy to invest in open access clusters (Valleys) where users can come for using instrumentation or research services. The valleys are established organizations where middle size infrastructure investments have a natural place.
 - The tendency of confounding institutional investments as NRI seem to be prevalent. Promising service to a large number of users may be a tool to secure investment for narrower purposes. Such manoeuvres are easily foiled in a large country with a number of well-organized scientific communities which are not operating in a small country.
 - Institutions may join forces to propose what is essentially a creation or an upgrade of institutional infrastructure across the country. This is a nationwide infrastructure program for producing a better research environment but not a NRI.
 - It is a science policy decision whether the same funds should be earmarked for nationwide programs which in sensu stricto are not creating a NRI but provide better infrastructure for research
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What is not a NRI?

Three possible ways of funding RI in Lithuania are: 1) institutional RI, 2) Valleys and 3) national RI.

Any investment into RI which can be financed locally and results in a RI that can be exploited by local research activity should not be handled as a NRI. Being open access is a necessary but not sufficient characteristic of the NRI.

A Valley is not a NRI but is a cluster of open access service oriented instruments, facilities and personnel. The instruments or facilities in the valleys are not necessarily unique and they may have counterparts in various institutional settings.

An institutional RI may or may not be open access depending on whether capacity is full booked by local users or not.

A simple collection of instruments is not a NRI. A unique collection of instruments dedicated to a definite purpose may be considered an NRI in case the purpose clearly requires complex instrumentations in a single RI entity. An infrastructure for the host institution which is also available for others in an open access arrangement should not be confounded with a NRI.

National research infrastructure evaluation and funding process

Background

The research policy in a country should have a complex approach to investment into instrumentation and other components requiring investment. Project level research needs (instrumentation, large scale services) have to be considered for funding at the project level, shared instrumentation and services can be provided at institutional, area or national level (valleys).

Research infrastructures at institutional, area and city level could be defined as local RI depending on the clients served and the capacity of the infrastructure. It is essential that local RI is also maintained in good working order. Every infrastructure need should be considered in its context and provided at a scale commensurate to its scope.

The national science policy should provide a balanced portfolio of mechanisms to provide investment funds at project level, at institutional or area level and at national level. Although the borders between these levels are sometimes blurred, unless each type of need is met by appropriate mechanisms, the research performers would invade other mechanisms for getting funds for their needs or the country's research capabilities will suffer.

The way project and institutional level research investments are handled is beyond the scope of this document. Here we only stress that appropriate mechanisms have to be in place.

NRI evaluation and funding

National RIs are important and unique investments for a long time scale, therefore the investments in the set of NRIs should be considered a staged process, not as a single opportunity. NRI selected for the country may be prioritized for immediate or delayed realization. The plans for NRI should be periodically revised, possible new opportunities or novel national infrastructure needs should be evaluated and every 3-6 years the plans updated.

A bottom-up process, consisting of public discussions – a national debate – about national RI should be organized by a special purpose panel and should include the universities, the research institutes and the Lithuanian Research Council (apparently such a process happened already). The research communities

should agree on the list of NRI that is nationally important and the priorities. The organizing panel may decide on the long list of NRI proposals. A first stage call for conceptual proposals should be launched for the long list of proposals. The proposal evaluation should result in a short list for the high priority NRI. The second stage call for proposals should require the submission of investment proposals with detailed technical, operational and business procedure plans. The detailed proposals will be evaluated by 2-3 technical experts (national and/or international) for technical and operational details and ranking of the RI will be performed by a mixed national and international panel.

Panels:

- Lithuanian expert panel should discuss and rank (with consensus or secret vote on ranks) all the ideas emerging from the bottom-up process.
- A multidisciplinary international panel consisting of experts with broad areas of expertise should evaluate the first round of proposals and produce a short list for the second round of evaluations.
- The (second) panel for the evaluation of shortlisted proposals should include national decision makers and international experts having experience with RI decisions and should base their decisions on analysis by international expert evaluators with specific experience for the technical and operational aspects of the proposed NRI.
- Funding decisions should take into account both the expert panels opinion, national research policy and priorities.

In the final decision about 70% weight may come from international peers and 30% weight may come from opinion of the national experts and policy makers.

The investment contracts

Contracts should include all relevant technical, organizational and financial details in the proposals. They should list all important criteria and appropriate milestones. Contracts should also specify maintenance and running costs and their sources.

Indicators of usage (reliable ones) should be included into funding agreements.

Miscellaneous aspects of NRI funding

Dual- or multipurpose infrastructures exist and are special cases where research and other uses share the infrastructure. Examples are medical installations, large computing facilities or other large infrastructures such as a nuclear power plant which may have important large scale research uses and may share investment, maintenance and running costs. Such investments need to be considered in their complex settings and should not be simply accepted as an NRI.

Every time when two or more national sectors benefit from the infrastructure the investment and costs should be shared by the sectors and respective Ministries. An example is health care where patient care and research use may intermingle. Proportions can differ – decision should be made case by case, possibly involving economist expertise. Proposals should describe the usage proportion in which RI will be used for different purposes.

The maintenance and basic operational costs of the NRI should be partially funded by the state, included in the contract and should be covered even if fees collected from users do not cover these costs.

Staged investment into an NRI could be considered. If a NRI is a complex technical or operational system which could be created as fully operational units, then the decisions may also be staged and taken years apart. It is important that the first decision should be (a) for a NRI which can be operational without further funding decisions and (b) staged later investments should be in the plans of future NRIs.

A NRI should have its capacity used extensively, may be up to at least 60 to 80%. If it is underused, then the wisdom of the original decision may be questioned and an investigation of the opportunities of changing the situation should be launched.

The way the maintenance and the operational costs (salaries, maintenance parts, consumables, and occasional smaller upgrading costs) will be covered should be also part of the funding decision and contract(s). Maintaining the facility in a good shape may require a yearly 2-5% of the total budget – these funds should be part of the proposal. It is a policy question whether the NRI can be used without costs to the research user or usage fees should cover a part or all of the running costs and/or the maintenance costs. Without ensuring that maintenance and running costs are covered one way or another a degradation and possible underuse of the NRI is likely. In contrast the usage fees may discourage the use the expensive NRI.

The policy of subventions for usage or charging the users may be different for different NRI used by different research communities. Industrial researchers should pay at least their calculated share of the running and maintenance costs.

Amortisation costs should certainly not be included in calculating the economies of the NRI.

The budget for NRI in Lithuania should be higher than the 27 mln. EUR this time foreseen for the next 7 years. It should be at least 35 mln EUR. This opinion takes into account the fact that several millions were already spent on various kinds of research and teaching infrastructures – on buildings, buying instruments, libraries etc. and this fact should be kept in mind. 27 mln. EUR is just on top of it.

Investment in the Valleys should be considered together with the national RI as strategic infrastructure investment and an analysis of the *return on the investment in the Valleys* should be scheduled. Evaluation both the scientific returns, the service to outside users, both basic researchers and applied researchers as well as the economics of the Valleys' operations should be evaluated by multidisciplinary teams, including scientists, economists and foreign experts of organizational performance.

Joining European research infrastructure networks

Decisions should be made very carefully.

Small countries should not join very expensive international RI unless there is excellent national science, which requires the use of international RI, and becoming members offers distinct value. Joining a large RI may starve of funds neighbouring fields of research. Being an observer in an international RI might the good option for the small countries. Whenever follow-up evaluation is being made - increase of international projects and all other output must be visible.

Pros and cons

Important to consider are the long term aspects of joining. Membership should not be switched on and off and on again.

Advantages

Joining European RI is likely to improve visibility of Lithuanian science and may increase the international flow of scientists.

There may be opportunities for returns (orders) for industries which could supply goods needed for the international RI.

Help for organizing and running an NRI may come from its European counterpart, which may have a program to help and train new members.

The European RI may have capabilities that the NRI does not have and Lithuanian scientists may be able to make good use of the European capabilities for their research projects. It may offer advantages in European level R&D applications

Caveats

Costs may be high for Lithuania, not necessarily at the beginning. It may syphon off important resources.

Benefits may not materialize because of lack of Lithuanian characteristic need. Possible underuse by Lithuanian scientists of a European RI is to be considered as a threat when deciding on joining a European RI.

Miscellaneous aspects

Running, evaluating operations, upgrading or decommissioning NRIs

Routine operations. NRI management should optimize usage to fill capacity with meaningful research. In allocating capacity, the researcher communities and the participating institutions should have decision power.

Planning for running the NRI should be included in the final investment plan and in the funding contract.

Feedback from all the users should be recorded in an anonymized manner, the survey being designed by professionals in consumer satisfaction studies.

Each NRI should have an *external* advisory board regularly reviewing all important aspects of the operations,

Evaluation committees have to be set up, representing users, funders, personnel and the society, including international experts. Every 3 to 6 years after completion of a RI, the performance of the RI should be evaluated. The first approach should be to investigate procedures and governance and attempts made to improve operations. If the performance is weak for a sustained period of time, or the developments in its scientific field make the NRI obsolete, or its importance is fading then RI should be (sometimes gradually) shut down.

Each valley should also have a mixed national and international review (reviewing the idea and the individual performance) in 5 years' time after the operational start.

Upgrading a NRI may be needed when technical or scientific advances make it necessary and feasible, Extending the service life of a well used NRI is to be considered at planned time points.

Terminating (decommissioning) a NRI may be considered at different time points for different reasons. If the decision to fund it was not based on solid evidence as shown by usage data in a few years and usage cannot be resurrected by reviewing governance, then terminating may be the only reasonable option.

Evaluation criteria

The same criteria which were used in selecting for funding should be used in evaluation of the operations. These may be supplemented by criteria set in the funding decision (contract).

Usage should be compared to capacity. If usage falls under 50% of capacity for a year from the second year on, the reasons should be explored by a review committee.

The time course of costs, down time, income (if any) from usage fees, maintenance costs. Operational aspects, administrative ease to request capacity or service. Scientific results, publications, patents that refer

to the use of the NRI. Wider influence, as reflected by national scientific performance in the field of the NRI, new spin-offs.

Attention should be paid to the operations of the NRI and periodical reports should be compared with the plans described in the investment contracts.

Cost of operation and the costs of maintenance should also be subject to scrutiny. Yearly usage statistics should be provided and unused capacity monitored.

Institutional infrastructures

It is important to deal with the good institutional research infrastructures proposals which cannot be funded as NRI. At least 3 scenarios can be considered.

1. The proposal might be reformulated (reorganized) to cover true national interests and reformulated proposals might be included in the plans for NRI.
2. For those infrastructure needs that are important and might be optimally met by distributed investment, a rational institutional investment plan with state budgetary resources may be the best solution. A review of the present proposals for a different kind of funding or a program for investment into institutional infrastructure may provide some leads.
3. Some of the proposals were considered by the Panel as being good project proposals rather than NRI proposals.

Assessing the socio-economic benefits of funded NRIs

A NRI is large scale and has national importance. When institutions share the same NRI national budget is spent in a more economical way than buying the same equipment for each institute.

Assessment of its direct and indirect benefits should also be on a national scale, not just considering the immediate usage data of the NRI. If the planned research benefits do not occur, then the socio-economic benefit are also likely not to happen.

Nation-wide considerations of the patents, technologies, spin-offs, start-ups, etc. in the field served by the NRI should be considered. Methodologies used in social sciences should be applied.
