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National research infrastructure analysis

"Core" research infrastructure

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Definition of the "core research infrastructure"

"Core" research infrastructure encompasses a wide range of facilities, technologies, and services with effective common governance, and provides world-class RI services and expertise in a specific field that are essential for supporting scientific research activities of a broad range of researchers across different disciplines both locally and internationally, as well serving R&D needs of companies and other organizations.

To be successful and internationally competitive, it has to be managed according to the best practices and provide high-quality RI services:

- has a separate RI maintenance and management unit with sufficient permanent employees who aren't students or researchers and aren't directly involved in research projects
- with its own annual budget, not directly funded from research projects (but its income can come from projects as deductions or internal fees)
- has implemented LIMS (with booking and usage accounting) and quality management systems
- open to external users, with formal access procedures, has a booking system that allows understanding the availability of necessary RI capacity or services and easily (remotely) schedule and reserve them
- has sufficient free capacity that can be allocated to external users
- provides users with necessary training, consulting, and support
- participates in international RI networks and is listed in the major EU-level RI & research services catalogs of the respective field.

Moreover, the infrastructure should be of significant size and *"interesting"* for the international scientific and R&D community. Our suggestion is that the "core RI" has above 1 million EUR in total value of significant, specific research instruments that each have a value above 100'000 EUR (excluding, e.g., desktop computers and other common hardware). It should have internationally unique or significant equipment or competencies, and internationally competitive specialization. Also large-scale, unique infrastructure, that can't be replaced (e.g., telescopes) can be considered as "core RI".

Other country examples of funding the "core research infrastructure"

For comparative analysis of RI funding approaches, we selected countries that are relatively well-performing in science and innovations, have relatively small population size, and are geographically located similar to Latvia. Among Baltic countries, Estonia ranks well in the number of publications and research excellence. Yet, it still has a relatively low citation count and the number of patent applications that serve as guiding KPIs when evaluating research and innovation systems.

Table 1. R&D outputs of the selected EU countries

	Articles published per 1mil. pop. (2018)	**Place in the world by citations (count) (2022)**	**Patent applications (WIPO 2022)**
Latvia	732	84th (3078)	108
Estonia	1070	72nd (5764)	26
Finland	1922	34th (33655)	1662
Sweden	2009	20th (67290)	2196
The Netherlands	1762	14th (97734)	3470

We chose Sweden, Finland, and Netherlands to analyze their RI funding since they have good performance in science and innovations (see Table 1.) and at the same time are comparable to Latvia regarding availability of natural resources and geographical location (impacting the economic structure), and relatively smaller population (impacting broadness of science and complexity of its governance).

Selected countries have proven that their research systems (including funding approaches) can be competitive internationally. They provide insight into successful approaches that Latvia might use to further RI maintenance and management funding.

Approach to funding research infrastructure in Sweden

Sweden's main body for research infrastructure evaluation and funding is the Swedish Research Council (SRC). They provide analysis, evaluation, mapping, and advice on future research policy questions to the Ministry of Education and Research.

The process of investments in Research Infrastructure and the development of the national research infrastructure a bottom-up process that begins with institutions expressing their plans and needs that are later evaluated by an international panel. All evaluated applications are listed in the National Roadmap, where they are categorized as "A1 ready for a call", "A2 funding currently not prioritized by the Swedish Research Council", and "A3 not ready for a call". Annual grant calls are open to the first category, "A1 ready for a call".

Which of the RI are moved to the A1 or A2 category of the Roadmap is an internal SRC decision. Often those in the A3 lack the argumentation for future business plans or are viewed as not competitive enough from a global perspective.

Among supported A1 projects are both the development of particular RIs as well as projects for 1) merging RI, 2) aligning RIs with international standards to make them comparable internationally and increase collaboration, or 3) opening access and sharing infrastructure, or moving the equipment to increase the utilization rate.

Swedish Research Council (SRC) announces annual calls for grants on specific topics or within a specific area of interest for research infrastructures. The applicants listed in the national RI roadmap have some priority.

To receive SRC funds, the research infrastructure needs to meet four selection criteria: 1) to be of national interest, 2) to be openly accessible to research, 3) have a long-term funding plan, and 4) the common organization with a higher education institution.

After submission of applications, an international panel reviews each one based on scientific, organizational, and technical criteria. The international panel is made up of international experts from various science fields and can evaluate applications from a larger, global perspective. The evaluation of the international panel is considered by the SRC when making final funding decisions.

Once the strategy and annual goals of the RI development has been established, the applications are assessed according to their scientific relevance, strategic and national relevance, and other aspects considered[1]:

- **national interest** – to what extent does the infrastructure fulfils, or has the potential in the future to fulfill the SRC criteria for research infrastructure of national interest

[1] See https://www.vr.se/english/applying-for-funding/calls/2022-10-25-grant-for-research-infrastructure-of-national-interest.html

- **ethical considerations**, where applicable
- **scientific impact** – does the application satisfies type of call, provides state-of-the-art capabilities for advancing research. Does RI have a sufficiently broad and sustainable scientific user base or potential comparing to similar infrastructures in other countries. Are there cost-efficient alternatives that would satisfy the same need
- **socio-economic impact** – the assessment of the RI's ability to provide benefits outside academic research (commercial use or societal benefit), including the UN global sustainable development goals and national innovation and economic impact
- **implementation, leadership, and organization** – feasibility of the proposal, adequacy of the organizational structure, appropriate and cost-efficient management structure; possessing necessary competencies in terms of scientific and strategic aspects and management; having relevant partners; both funding and personnel at an appropriate level and sufficiently secured; potential risks assessed; relevant collaborations with other infrastructures described
- **consortium** – is the suggested form of consortium appropriate to fulfill the needs; in case of a consortium, are all organizations relevant for the infrastructure
- **e-infrastructure** – appropriate data policy and data management plans; does the technical solution provide access, analysis, active data storage, and data management; sufficient support for users in terms of software, development of user-specific tools, and database solutions; readiness to sustain the growing need for e-infrastructure; when applicable, has the infrastructure consulted and coordinated with other infrastructures to ensure that necessary e-infrastructure is available for users
- **prioritization between functionalities or components** – which components are central or highly relevant; can components be identified as relevant or less relevant; is the budget of each component reasonable and cost-effective in terms of personnel, equipment etc.?

The national interest is further defined through the following criteria:

- enables research of the highest scientific quality
- are openly accessible primarily to researchers but also to the business sector, the public sector, and other relevant actors. When access is limited, prioritization of criteria shall primarily be based on scientific excellence
- creates clear national added value
- have long-term plans for the scientific operations and their development
- take long-term responsibility for management and control, funding, competence accumulation, and development of the operation
- contribute to societal development, e.g., enables research that addresses societal challenges.

Proposals for new areas of research that are prioritized within the calls. However, applications for new and existing RIs should be joined in a single submission[2].

The assessment of applications is done by the International Panel Experts and the Council for Research Infrastructure (RFI) involving the e-infrastructure committee and three advisory groups of experts (professors, directors, researchers) in different scientific fields: Group A for databases and infrastructure for analysis and materials for humanities, medicine and social sciences, Group B for observatories and measuring platforms for astronomy, the climate, the environment and earth sciences, and Group C for high-tech laboratories for physics, and chemistry, as well as materials, engineering and life sciences.

The evaluation of application has two stages:

1) an initial review of applications and sending out supplementary questions to the applicant. SRC usually inquires about the applicant's budgetary items and reviews the application, after which a written statement is released to the advisory group on the applications and their scientific value.

2) in the second stage, the advisory group collects reviews form the SRC, international panels, and e-committees, and uses them to prioritize applications. After the prioritization, the dialogue with the chosen applicants and their administrative bodies begins regarding project content and follow-up of the infrastructure operation. Based on the dialogue, the SRC makes the final decision, deciding on the amount of funding, and special terms and conditions for the infrastructures to receive the grant.

Approach to funding research infrastructure in Finland

Finnish Research Infrastructure Committee (FRIC) altogether has a chair and vice chair, a permanent expert, and 15 members that are university rectors, research center CEOs or Directors General, members from the Research Council of Finland as well as the ministerial representatives from the Ministry of Economic Affairs and Employment, Ministry of Social Affairs and Health, Ministry of Health and the Environment, and the Ministry of Education and Culture.

FRIC monitors and develops Finnish and international research infrastructure activities, submits proposals to the Academy Board on long-term RI plans, selects projects to be funded, and monitors them.

[2] See https://www.vr.se/english/just-now/news/news-archive/2022-10-13-these-can-now-apply-for-grants-to-research-infrastructure-2023.html

Funding awarded by FRIC are meant to upgrade and construct research infrastructure, not to maintain it or fund research (Strategy for National Research Infrastructures In Finland 2020-2030, Academy of Finland).

FRIC announces grant calls annually. Depending on the needs of the Research Infrastructure, they can be targeted at specific groups of RIs. E.g., within the Recovery and Resilience Plan 2022, the grant call was announced for the local research infrastructures to support closer collaboration between RIs and regional R&D&I actors. The objective was to fund upgrades to existing or currently under-construction infrastructure to support their greater resilience in the digital landscape (for digitalization, automation, sustainability, etc.).

Figure 1. A general overview of the criteria and objectives of the grants to Research Infrastructure

6. Criteria of the decision-making process in the RM procedure		
Eligibility criteria	**Evaluation criteria**	**Feasibility criteria**
A RI must: • provide potential for world-class research and scientific breakthroughs, • be of broad national interest and enhance the international impact, • have a long-term plan for scientific goals, maintenance, financing and utilisation, • be used by several research groups/users for high-quality research, • be open and easily accessible to researchers, industry and other actors, • have a plan for access to and preservation of collected data and/or materials, • be extensive enough so that individual groups cannot manage them on their own, • introduce new cutting-edge technology (if relevant.	For RI which are in operation or designing or implementation phase[4]: 1. Scientific quality and potential 2. Open access and utilisation 3. Relevance to the strategies of host institutions 4. National and international relevance 5. Feasibility and Sustainability (for detailed information see link to document[5])	The feasibility of the project is assessed on the basis of the technical, institutional (e.g. form of ownership, terms of use or membership) and personnel requirements during the whole life cycle of the RI: Planning costs Investment costs: • Construction/Building (incl. manpower) • Acquisition of real estate • Special technical equipment • Supply/construction of devices and equipment Operating costs: • Personnel costs (e.g. operation, maintenance, user support) • Material costs (incl. membership fees or other payment of contributions to organisations) • Costs of running the premises (rent, electricity) • Other noteworthy investments (replacement purchases) required to keep the research • infrastructure and equipment on an adequate level, reflecting the state-of-the-art Decommissioning costs: • Costs of closing down the business and conservation of the resources developed

Similar to that of Sweden, selection and evaluation critical include the significance of research (high added value), cooperation and impact for regional specialization and business regeneration, ownership (a clear division of the rights, obligations, and roles of the owners), sufficient expertise and know-how within the existing RI, services and users (clearly described access procedures for different types of users), digital platforms and data (supports digitalization and big data), emphasis on responsibility and green transition, clearly outlined long-term funding plans for the maintenance and development of services (sustainable business plan for at least five years), and evaluated and assessed risk management (see Picture 1.)

At least two expert panels review applications. After reviews, panel members hold a joint meeting on the application and their assessments, and agree to release a joint statement on the application rating.

Not necessarily that reviewers are international experts. They can be nationals that are chosen considering possible conflict of interest with the applicants. Conflicts of interest are considered both at personal and professional (past three years) levels, e.g., if have applied for the same funding instrument; has collaborated with the applicant; is in managerial, subordinate, or instructor position with the applicant, etc.

FRIC makes the final funding decision.

Approach to funding research infrastructure in the Netherlands

Similar to Finland and Sweden, the Netherlands has a Dutch Research Council (NWO[3]) that provides grants for funding high-risk research and covering up to 75% of costs for setting up new RI. NWO is a part of the Dutch government. It has an executive board and supervisory board, and the presidents are appointed by the Ministry of Education, Culture and Science.

Applicants for Research Infrastructure calls are encouraged to develop international platforms and research consortia. Often projects have a long-term funding plan for up to five years, but the Research Infrastructure must be used longer. Grant calls for research infrastructure are announced annually. Grants cover costs for scientific equipment and databases, personnel for the infrastructure setup, and international memberships.

The latest call from 2023 considers large-scale infrastructure investments that follow the outlined National Roadmap. The National Roadmap includes and prioritizes RIs that significantly contribute to innovation and help solve major social issues related to the environment, climate, health, and

[3] See https://www.nwo.nl/en/supervisory-board-of-nwo

civilization. For evaluating economic and scientific significance a permanent *Strategic Conference Permanent Committee on National Institutes (PCNI) about infrastructure*[4] has been established.

To apply for grants, the RI has to be listed in the National Roadmap and Strategy (closed calls). The listed institutions can apply individually or in consortiums.

Applications must justify:

1. Relevance of RI:
    1. relevance to the national research strategy (National Roadmap)
    2. relevance to international strategies (e.g., Sustainable Development Goals)
    3. current scientific breakthrough that motivates the development of RI or an expected scientific breakthrough
    4. consortiums
2. Impact and added value:
    a. available capacity v/s required capacity by users for the RI
    b. has a clear access policy that enables access for different types of users
    c. list of services provided to scientific users and their impact on its users
    d. impact on other scientific fields
    e. socio-economic impact
    f. importance of generated data (how data is generated and made available to benefit the science, society, and economy)
3. Organizational and financial aspects:
    a. decision-making structure
    b. plan for education and training of users
    c. strategies for procurement, IP, and commercial activities
    d. key performance indications, milestones, and deliverables of the RI
    e. detailed plan of financial feasibility and sustainability after the end of the RI grant (sources of income, commercial use, expected capacity and utilization, running costs, dismantling costs) and how this commitment is guaranteed

If there are more applications than the total amount of grant available, the application assessment begins with pre-selection by four criteria (scientific quality, impact, organizational and financial aspects, technical aspects).

[4] See https://www.nwo-i.nl/en/artikel/strategische-conferentie-permanente-commissie-nationale-instituten-pcni-over-infrastructuur/

In the next stage two external experts are assigned for an application. Each expert can review only one application per year and is not paid, their identity is confidential. Expert submits a review to the NWO and forwards the report and comments to the applicant, who can appeal it. If NWO is satisfied with the review, the process is followed by an interview and a site visit.

The selection committee consisting of volunteering senior researchers assigns scores to all applications. NWO, follows their ranking and funds projects until the budget is exhausted. NWO may follow a fair distribution of funds between science fields instead of strictly following the ranking.

Highlights of approaches to funding research infrastructure in other countries

- ESFRI criteria for evaluation of RI investments can be used as they cover most of important aspects and foster internationally unified approach.

Figure 2. ESFRI criteria for evaluation of RI investments

Objective	KPIs
Enabling scientific excellence	1. Number of user requests for access 2. Number of users served 3. Number of publications 4. Percentage of top (10%) cited publications
Delivery of education and training	5. Number of master and PhD students using the RI 6. Training of people who are not RI staff
Enhancing collaboration in Europe	7. Number of members of the RI from ESFRI countries 8. Share of users and publications per ESFRI member country
Facilitating economic activities	9. Share of users associated with industry and publications with industry 10. Income from commercial activities and the number of entities paying for service
Outreach to the public	11. Engagement achieved by direct contact 12. Outreach through media 13. Outreach via the RI's own web and social media
Optimising data use	14. Number of publicly available data sets used externally
Provision of scientific advice	15. Participation by RIs in policy related activities 16. Citations in policy related publications
Facilitating international co-operation	17. Share of users and publications per non-ESFRI member country 18. International trainees 19. Number of members of the RI from non-ESFRI countries
Optimising management	20. Revenues 21. Extent of resources made available

- Germany has strict rules for awarding RI grants. RIs are required to provide a long-term business plan that guarantees operation costs at least 10 years after the development phase.
- RI grants are often aimed at developing new or upgrading existing RIs. Specific tools for funding maintenance are not common. Institutions are required to secure themselves the funding for running and maintenances of the RI, and justify it in their business plans. Sources might include research funding, institutional base funding, education funding and other income from national or regional budgets as well as income from R&D contracts.
- There is a need for long-term business plans of research infrastructures to ensure the sustainability for RI investments.
- When assessing the required RI capacity v/s available, all users have to be taken into account (consortiums, higher education institutions, etc.).
- Insufficient responsiveness of the research system to non-researchers is a common phenomenon, leading to limited socio-economic impact. Also, research infrastructures underperform when there is a mismatch between 1) the research activities as well as number and areas of degrees provided by universities, and 2) regional societal needs (see Estonia's RI Peer Review, 2020). There should be policies aiming to minimize the mismatch and foster mutual learning.
- Establishing a centralized body (e.g., National Research Council) tasked with developing a system-wide strategic planning for significant research infrastructure helps to improve international competitiveness of the national RI.

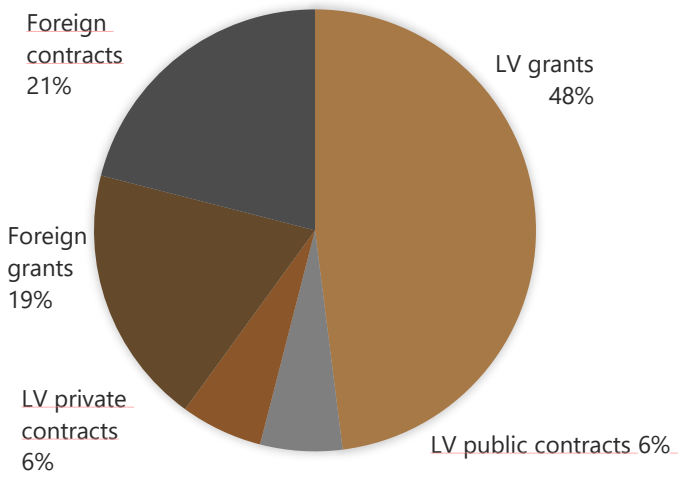
Latvian "core research infrastructure" analysis

Most of the RI work in STEM and technical sciences. When asked to assign the FORD classification to their activities, 33 RIs reported working in Natural sciences, 10 in Biological sciences, and 8 in Computer and information sciences. Also, 32 RIs work in Engineering and Technology, 8 in Materials engineering, and 6 in Electrical and electronic engineering. A much smaller number of RIs (13) work in Medical and health sciences, 11 in Agricultural sciences, 8 in Humanities, and 4 in Social sciences.

RIs report covering all areas of the Latvian economy specialization. From the RIS3 perspective, most RIs work in "Biomedicine, medical technologies, pharmacy" (21 RIs), and in "Photonics, smart materials, technologies, and engineering systems" (20 RIs). Also, many RIs reported "Knowledge-intensive bioeconomy" (16) and "Information and communication technologies" (14) as their smart specialization areas. Fewer institutions are in Smart energy and mobility (9).

Answers about specialization in FORD and RIS3 provide limited value for policy development. Each RI institution aims to demonstrate activity in a broad range of areas. Therefore, it is difficult to assess both the specialization of the particular RI and integration within the specific sector or field, as well as the capacity and competitiveness of the particular sector or field.

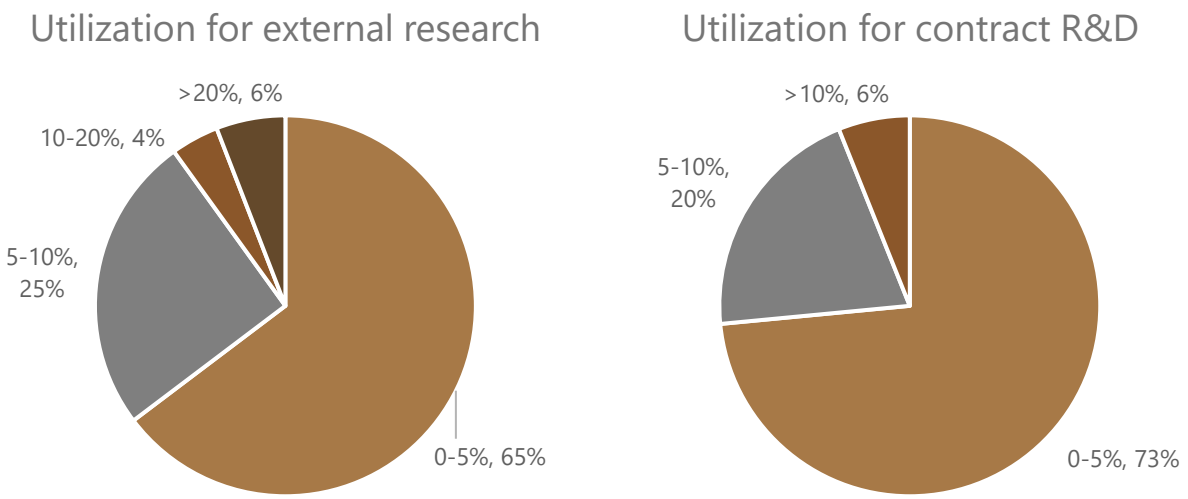
Figure 3. A proportion of income by source.



Formally, research infrastructures are actively involved in all smart specialization areas of the Latvian economy. In reality, of the reported annual institutional income of 57 million EUR, 67% is from Latvian or foreign research grants, only 6% from Latvian business contracts, and the other 6% from domestic public contracts (see Figure 3).

The actual use of the RI for external needs is low. For 65% of the equipment units, usage for needs of external research groups was below 5% of the capacity, and for the next 25% of the equipment units, the usage for such needs was between 5%-10% of their capacity. For serving business needs, the respective numbers are 73% below 5%, and the next 23% between 5%-10%. (see Figure 2)

Figure 2. Utilization of infrastructure units for external users.



Moreover, 63% of all domestic public and private contracts income goes to three institutions. Another two institutions have a significant part (>10%) of their income from public domestic contracts. These examples are related to the high overall R&D activity in the particular sector or because they perform publicly funded functions.

The low numbers indicate insufficient product-market fit, supposedly due to "thin" market in Latvia. Consequently, a limited understanding of the potential market, insufficient foreign orientation, and a lack of competitive specialization at the global level of the RI and services.

* * *

The following suggestions regarding the potential "core" RIs are based solely on survey responses that might be inaccurate and incomplete. When applying for "core" RI status or RI maintenance funding, institutions might provide more detailed and accurate information, significantly impacting their classification.

The majority of the Latvian institutions currently vaguely fit "core" RI requirements even if their instrument base is strong. Their weakest point is insufficiently developed management and maintenance. The strongest potential to be considered as a "core" institution is for CFI (all RIs), BIOR, OSI, and RTU HPC Center. Of smaller scale but still qualifies EDI, LUMII CLARIN-LV, and DI. Because of large-scale, nonreplaceable instruments, VEAVSRC and LU Astronomy and Space Geodesy Research Center fit "core" RI. Still, some of these institutions have to improve maintenance and management procedures to be considered competitive "core" RIs.

If RI management and maintenance are improved, some additional RTU RIs might qualify as "core".

The quality of answers has impacted the assessment of several RIs. Therefore, BMC is split into several RIs, each of them becoming less significant. KKI and SILAVA have weak responses regarding their management and access procedures, impacting their assessment.

LULFMI would qualify as "nationally significant RI" having collections that are important for Latvian culture and society. There is a potential to develop a strong "core" RI in humanities if LULFMI joins forces (common management of resources and services) with other collections of cultural artifacts (e.g., archives, museums, libraries).

Also, several other institutions could jointly form internationally competitive "core" RIs. In computing and data, a joint RI between BMC Bioinformatics Centre, EDI, LUMII Data and Cloud Computing Centre, and RTU HPC Center could be formed. In biotechnology, biosynthesis, and polymer science – between BMC Biotechnology Center, KKI, RSU Laboratory of Finished Dosage Forms, RTU Polymer Materials, and RTU Biosynthesis.

Recommendations for funding the core" research infrastructure"

The goal of maintenance funding policy is to foster the development of a "core" research infrastructure that provides world-class RI services and expertise, and supports scientific research activities of a broad range of researchers both locally and internationally, as well as serves R&D needs of companies and other organizations. This funding is not aimed at supporting the respective institution's research activities *per se*.

Separate funding for RI maintenance might be a temporary policy tool incentivizing the development of high-quality RI services. After policy goals are achieved and sustainable funding for maintenance is established, this funding could be integrated into base funding or costs of research or R&D projects. Further, infrastructure investment calls might ask institutions to demonstrate sufficient means in their business plans to cover future maintenance costs of the new equipment.

Besides supporting "core" RI, there should be policy tools to support the development of management and maintenance for smaller-scale RIs at universities (higher education institutions), as separate tools or integrated into other policies for education or research.

Funding tools should account for the maintenance of premises and auxiliary equipment.

To foster the development of internationally competitive RIs, it is advised to appropriate the funding to the most competitive institutions instead of dispersing it to all.

Due to significant variations in reported indicators and the lack of objective source data for constructing or verifying them, it is not advised that RI policy (funding) tools are based solely on indicators due to questionable accuracy and the potential administrative burden. Also, tools should possess minimal red tape and collect minimum additional information from applicants.

Selection criteria

To qualify for maintenance funding, institutions have to conform to criteria for well-maintained "core" RI (as listed in Chapter 1.5):

- has a separate RI maintenance and management unit with sufficient permanent employees (and more than one FTE) who aren't students or researchers and aren't directly involved in research projects

- this unit has to have its own annual budget instead of being directly funded from research projects (but its income can come from research projects as deductions or internal fees)
- has implemented LIMS and quality management, consistent accounting for usage, staff, costs
- open to external users, with formal access procedures, has a booking system that allows understanding the availability of necessary RI capacity or services and easily (remotely) schedule and reserve them
- has sufficient free capacity that can be allocated to external users (utilized below 70-80%)
- provides users with necessary training, consulting, and support
- participates in international RI networks and is listed in the major EU-level RI & research services catalogs of the respective field.

These criteria as well as other management and maintenance requirements can be introduced gradually, allowing institutions to catch up with them, and they should be supplemented with other tools (investments) allowing institutions to improve their management and maintenance.

Further, the infrastructure itself should be of significant size and *"interesting"* for the international scientific and R&D community:

- above 1 million EUR in total value of significant, specific research instruments that each have a value above 100'000 EUR (excluding, e.g., desktop computers and other common hardware)
- or large-scale, unique infrastructure, that can't be replaced (e.g., telescopes)
- or "nationally significant RI" having collections that are important for Latvian culture and society
- having developed internationally unique or significant competencies, and internationally competitive specialization.

Furthermore, RIs can receive a higher assessment, if:

- there is a designated staff for RI strategy and service development
- there is a development strategy and business plan for RI (separate from the research agenda)
- infrastructure and its services are unique in Europe
- the quality management system is certified
- has a Seal of Excellence
- a significant proportion of equipment is covered by service agreements
- a significant amount of income is from abroad or contracts in Latvia. This indicator should be used as pass/fail and not proportional to the respective income (e.g., >5% of income from EU frameworks, >5% from foreign contracts, >5% from contracts in Latvia).

(Any of these indicators can be used as additional selection criteria for "core" RI)

Calculating maintenance funding

Funding to selected "core" RIs should be appropriated by formulas based on simple indicators because calculating real maintenance costs would introduce a significant administrative burden with limited accuracy and credibility. The amount could be calculated using:

- total asset value of the specific research equipment (excluding premises, auxiliary equipment, and common hardware) * k_1
- RI users in FTE * k_2

Additionally, if the following RI costs and revenues can be credibly assessed, the calculation might include:

- foreign income and income from contracts in Latvia * k_3
- fixed, significant maintenance costs (e.g., electrical power) * k_4

The funding could be designated to cover specific maintenance costs, asking institutions to submit them. If institutions have submitted a request to cover a specific amount, then the assigned funding shouldn't exceed it.

Procedures for granting maintenance funding

1. "Core" research institutions apply for maintenance funding and submit all data necessary for evaluation of their eligibility as well as for calculating the funding.
2. Experts assess if the RI corresponds to "core" criteria (e.g., quality of management and maintenance, uniqueness and competitiveness of instruments, competencies, and services). Submitted data might be audited if necessary.
   A committee of experts, representatives from society, and policymakers assesses if the infrastructure is "nationally significant RI".
3. The expert-ranked list of "core" RIs is submitted to the committee of experts, representatives from society, and policymakers for assigning priorities.
4. The committee of experts and policymakers makes a decision to assign the funding for the next 2-3 years, rolling.

Other recommendations for development of the "core research infrastructure"

At this moment, strategic, top-down infrastructure development policy oriented towards domestic RIS3 goals can't be advised. Research institutions have insufficient exposure to the domestic and foreign markets, leading to inadequate integration and incomplete information. Moreover, focusing on the domestic R&D market would restrict RI potential since the domestic market is small (*thin*), and often its needs, production capacity, human resources, managerial skills, and business strategies don't match RI specialization.

Instead, RI development policies should focus on emphasizing the strategic advantages of competitive RIs (*"picking winners"*) and furthering their international specialization and competitiveness, and supporting competitive R&D collaborations between RIs and businesses.

Establishing a modern RI management system (both LIMS & processes) is a prerequisite for further opening the RI and improving its international competitiveness, for efficient management of the RI and providing flexible, high-quality services, as well as for monitoring, evaluation, and designing targeted, cost-, resource- or result-based funding tools.

The potential of using RI in business will increase with the improvement of their management. Common needs of companies should be taken into account when managing RIs – having staff for discovering clients and their needs, integration of services provision in lab operations, and having certified quality management (ISO9001 or ISO17025).

Support for contracted, collaborative R&D projects should be emphasized over providing boutique "plain" infrastructure services to businesses, as they better fit RI competencies and increase mutual understanding. However, to cover company needs, RIs should have competencies and procedures in place for being able to provide common analytical procedures that aren't available on the market (certified, if there is a demand). Also, there might be support for the development of specific, competitive large-volume standardized RI services.

Additional policies should be aimed at increasing the exposure of research institutions to markets and research collaborations. Especially, aimed at discovering foreign markets and collaborations, since it improves knowledge transfer and learning best practices.