VISIONARY ANALYTICS

ASSESSMENT OF INVESTMENTS FOR SMART SPECIALISATION IMPLEMENTATION IN LITHUANIA

FINAL REPORT

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CONTENTS

LIST OF ABBREVIATIONS

BSR	Baltic Sea Region
DG REGIO	Directorate General for Regional and Urban Policy
EC	European Commission
E-Lingua	Research infrastructure 'Electronic Lithuanian language resources'
ESFRI	European Strategy Forum for Research Infrastructures
ESS LT	Research infrastructure 'European Social Research'
EU	European Union
FP7	7th Framework Programme
HEI	Higher education institutions
HUMRE	Research infrastructure 'Human wellness and development research'
ICT	Information and Communication Technologies
PFSA	Project funding terms, liet. *Projektų finansavimo sąlygų aprašas*
MAO	Research infrastructure 'Molėtai Astronomical Observatory'
MoES	Ministry of Education and Science
MITA	Agency for Innovation, Technology and Science
OECD	Organisation for Economic Co-operation and Development
OP	Operational Programme
R&D	Research and development
RDI	Research and development and innovation
RI	Research and development infrastructures
S3	Smart specialisation strategy
SF	Structural Funds
SME	Small and Medium Sized Enterprise
SO	Specific objective
Valley	Integrated centre of studies, science and business

INTRODUCTION

As part of the Europe 2020 strategy, the Commission adopted the 'Innovation Union' flagship initiative in October 2010. It sets out a comprehensive innovation strategy for Europe to enhance Europe's capacity to deliver smart, sustainable and inclusive growth. Investing more into research, innovation and entrepreneurship is at the heart of Europe 2020 and a crucial part of Europe's response to the economic crisis. So is having a strategic and integrated approach to innovation that maximises European, national and regional research & innovation potential. This has been highlighted by the Communication 'Regional Policy contributing to smart growth in Europe 2020' published in October 2010. It encourages the design of regional research and innovation strategies for smart specialisation as a strategic and integrated approach to harnessing the potential for smart growth and the knowledge economy in all regions. These strategies should also be instrumental in investing Structural Funds more efficiently.

Smart specialisation is one of the key elements of the European Commission's proposal for a reformed cohesion policy as ex-ante conditionality for the use of ERDF in the next Structural Funds programming period 2014-2020. This means that a pre-condition for a project to receive financial support under the ESIF under the thematic objective 1 is to be in compliance to the Smart specialization areas chosen. Lithuania prepared a number of documents[1] in the framework of Smart specialisation and on 21 April 2015 DG REGIO concluded that Lithuania fulfils the ex-ante conditionalities 1.1 'Research and innovation' and 1.2 'Research and innovation infrastructure'. This allowed Lithuanian authorities to start drafting the selection criteria, develop measures for financing and define the lists of projects.

In line with the terms of reference, this report:

- Analyses and provides conclusions on how the measures and selection criteria prepared by the ministries for thematic objective 1 comply and contribute to Smart specialisation priority area action plans;
- Assesses and provides conclusions on the compliance of the General action plan[2] for the implementation of Lithuanian Smart specialisation strategy actions which are under the competence of Ministry of Education and Science (MoES), incl. list of projects, to Smart specialisation priority area action plans.

The scope of assessment consists of the following measures and projects:

- **18 policy measures** under the Lithuanian Operational programme (further on – OP) for 2014-2020, Thematic objective 1. These measures are listed in the Tables 2, 3 and 5 in the Chapter 1. By the time when this report was prepared[3] five measures under Thematic objective 1 had approved their project funding terms (further on – PFSA) and project selection criteria. Another eight measures have published online (www.esinvesticijos.lt) their draft PFSAs. Only those 13 measures could be assessed in detail. Any comments or calculations based on draft PFSAs should be considered preliminary, because the terms and budgets indicated in the draft PFSAs are constantly changing.
- **31 policy measures** indicated in the General action plan for the Implementation of Smart Specialisation strategy actions under the competence of the MoES. For the full list of measures see Table 6 in the Chapter 2. Measures linked to thematic objective 1 were given more attention.
- **25 pre-selected projects** indicated in the General Action Plan on the Implementation of Smart Specialisation under the competence of the MoES. For the list of projects see Table 7.

The report findings are based on documents review, including the meta-analysis of previous reports and expert recommendations prepared for Lithuania during 2013-2016.

[1] Source: http://ukmin.lrv.lt/lt/veiklos-sritys/inovaciju-veiklos-sritis/sumani-specializacija
[2] Source: https://www.e-tar.lt/portal/lt/legalAct/acc2f37041bd11e58568ed613eb39a73
[3] July 2016.

1. POLICY MIX UNDER THE OPERATIONAL PROGRAMME FOR 2014-2020

This chapter provides conclusions on how the measures and selection criteria prepared by the ministries for thematic objective 1 of the Lithuanian Operational Programme for 2014-2020 comply and contribute to the implementation of the Lithuanian smart specialisation priorities.

1.1. Methodology

The following criteria are used for the assessment of the 18 measures under thematic objective 1 of the Lithuanian OP for 2014-2020.

1. Compliance with goals of the aims and logic of the smart specialisation priorities' action plans and their implementation roadmaps.
2. Coverage of specific gaps of research, development and innovation (further – RDI) policy as listed in the reoccurring recommendations in the policy evaluation reports and expert reviews carried out during 2014-2016.
3. Compliance of with the aims and targets of related specific Objectives 1.1, 1.2.1 and 1.2.2 of the thematic objective 1 of Lithuanian OP for 2014-2020.
4. Satisfaction of requirements for successful implementation. The requirements for successful recommendations are also based on the recommendations from previous reports, including the background reports of the International Independent Experts Group and six expert panels used for defining the 20 smart specialisation priorities and their implementation roadmaps.

The key documents sources for this assessment are: priority implementation roadmaps and plans, and the project selection and funding guides (PFSA) and specific project selection criteria.

1.2. General assessment of OP measures according to the logic of priorities' roadmaps and action plans

Methodological assumptions in the priorities' roadmaps and their action plans

The methodological approach to the roadmaps (Visionary Analytics et al., 2014) that provided the basis for the implementation of 20 Lithuanian smart specialisation priorities consisted of several principles. **First, each priority is to be implemented in stages, in order to ensure orientation towards results**. The major change needed in Lithuania is the shift from 'research for the sake of research' to the 'research for the sake of economy' and economic results. Therefore it was assumed that implementation of the priorities should follow a 'stage-gate' approach. The priorities could be reviewed and funds reallocated if the priority is not viable (does not achieve expected interim targets). The stages were defined according to the technology readiness stages:

- Idea – search for new solutions. This stage comprises the results necessary for finding new solutions to existing problems and challenges and/or problems that have not been defined during the smart specialisation process.
- Concept – an R&D activity contributing to the development of a technology concept, model methodology, up to the stage where a prototype is created.
- Development – development and testing of technology prototypes, as well as pilot manufacturing.
- Introduction to the market – manufacturing of new products and delivery of new services to the market.
- Generation of critical mass of new companies: activities for knowledge transfer and diffusion to as many potential users as possible. This activity is a necessary precondition for successful transformation and structural change in the economy.

Second, roadmaps took into account different maturity of the priorities, for example, their readiness to implement large scale collaborative R&D projects, launch products or implement infrastructure projects. It was assumed that **an allocative rule (quotas) would be applied to keep the balance.** In the case of lower maturity, the implementation of priorities should start with building the cooperation and absorptive capacities, networks and active generation of R&D projects (brokerage and other innovation support services).

Third, calculations of quotas per each policy instrument for each of 20 smart specialisation priorities were made using these criteria:

- There is a market failure that can be addressed by policy interventions – State investments are only justified if the companies or research groups do not have the capacity to create the intended results with their own means. Therefore: (a) State's investment should be largest in those stages of technology development where the risk is highest, investment of business should be largest in the stages of lowest risk; (b) the State should cover part of the cost of quasi-public institutions, such as networking platforms, knowledge circulation and creating ecosystems for start-ups.
- Private sector should be ready to co-invest in the implementation of the priorities during 2015-2020. Creation of large scale R&D infrastructures or large R&D projects is largely unjustified in those fields where there is no previous business innovative activity. In such cases investments into experimentation, innovation capacity building, innovation brokerage and creating a pipeline of smaller R&D projects (including spin-offs and spin-outs) is better justified.
- Policy interventions should take into account the product development cycle and speed of placing it into the market. Large scale joint business-science R&D projects are justified when there is a need to coordinate the development of many components and the development of a technology is a long and difficult process involving many actors (e.g. robotics, industry lasers). If the technology cycle is short (e.g. ICT services), the demand for many small projects (funded by 'Innovation vouchers LT' or 'Intellect LT') is more likely.
- Empowering the technology users. If the created results will be used by public institutions (e.g. in the case of learning, health and transport innovations), innovations should be created with the help of pre-commercial procurement. It would allow the final user to get involved in defining of the product concept, approving and testing the prototype, etc. The involvement of final users in such cases should be ensured starting with the first stages of implementing the related priorities.

Fourth, the priority roadmaps report (Visionary Analytics et al., 2014) emphasized these implications:

- Search for new ideas and solutions has to be a continuous process. Sufficient time and incentives for entrepreneurial search should be granted, taking that even for the more advanced priorities the S3 approach assumes change and alignment of activities. In practice, it means that the State should support collaboration and provide incentives for experimentation to encourage entrepreneurs and other organisations to become involved in the discovery of specialisations and opportunities for diversification therein.
- Implementation of the priorities will unavoidably face many risks, therefore there is a need for timely and effective monitoring information on the success of the implementation progress. It implies that priorities' review procedures should be put in place. Some priorities can fail, and new prospective fields can emerge, hence intelligence and review procedures should allow for flexibility. A process for regular review of the priority areas must be put in place, with the possibility to renew the priorities based on specific reported outcomes. Reviewing the priorities should be organised so that the support will not be discontinued too soon, nor continued so long that subsidies are wasted on non-viable priorities. The challenge is to prevent the evaluation process from being captured by the interest groups.
- Broad approach to innovation has to be adopted, ensuring the various types of innovation are supported.

Assessment

On the surface, the policy mix reflects the S3 priority actions plans up to 70-80%. But 'devil is in the details', - deeper assessment reveals several risks discussed below. The overall assessment is provided in the table below.

Table 1. Assessment of compliance to the OP intervention logic and S3 priority action plans

Assessed measures and projects	Meets the OP intervention logic and gaps in the national innovation system	Meets the smart specialisation action plans and roadmaps
Specific Objective 1.1. Promoting more active use of the existing and new RDI infrastructure	Low	Medium
Specific Objective 1.2.1 Increasing private RDI investments	Medium - high	High
Specific Objective 1.2.2. Increasing knowledge commercialisation and technology transfer	Medium	Medium - high
Projects in the General S3 Action Plan under MoES to be funded by Priority Axis 9	Not evaluated under this contract	Low

Source: prepared by authors.

First, there are critical issues related to the content of measures under OP Objective 1.1. Nearly half of infrastructure development projects under the General S3 Action Plan under the MoES are only weakly (if at all) linked to any of the S3 priorities, same as a few projects planned under the measure 'Development of RI and its integration in the European infrastructures' (E-Lingua, ESS LT, MAO, HUMRE). The related infrastructure projects are assessed in detail in the Chapter 2.

Second, funding for several measures enabling active use of RIs has been substantially reduced:

- Funding for 'joint business-science projects' and 'purposive' R&D projects has been substantially reduced (by €35m and €12.3m accordingly[4]);
- Funding for clusters (collaborative RDI platforms development) has been reduced more than twice (by €42m);
- The 'Precommercial procurement' measure (€29.4m) was not indicated in the priority action plans, but it was indicated in the priority roadmaps and their relative calculations;
- Measure 'SmartparkLT' (€13m) was initially not included in the priority action plans or roadmaps, because it was considered a general measure of SME competitiveness;
- The budget of R&D infrastructure measures is €18m smaller compared to the total budget of all related measures in the priority action plans; it can also be assumed that part of this infrastructure has been moved to other thematic objectives in the OP (e.g. under measures for modernisation of the studies' infrastructure).

Reduction of this budget can be partly justified by introduction of new relevant measures (e.g. focused on FDI). However, reallocation from Specific Objective 1.1 would have been better justified in such a case (see first conclusion above).

Third, it seems that the suggested 'stage-gate' monitoring and funding approach was seen as costly (requiring additional resources and capacity building) and was therefore **abandoned**. At least there is no indication of interim targets foreseen in the priority implementation roadmaps, or the 'stage gate' approach in the PFSAs.

Fourth, quota-based approach has been abandoned by Specific Objectives (SO) 1.21 and 1.2.2, and SO 1.2.1 indicate quotas at the level of six broad priority areas, although there are huge differences (up to 10-30-fold) in terms of budget allocated per different priorities in the same priority area. There is a risk that some priorities dominate the others, or too much funding is dispersed for the priorities that are not ready for specific instruments and hence weak projects are funded. On the other hand, excellence criteria used for each priority area can lead to funding best projects – it will depend on the quality of content evaluation. Overall, it is an advantage that projects compete in 'their' priority areas. After comparing the budget quotas indicated for specific priority areas in was noticed that):

- Combined share of budget per priority area in the measures 'IntellectLT. Joint science-business projects', 'Innovation vouchers' and 'InopatentLT' in general meets the combined share of similar measures indicated in the priority plans (there are only minimal deviations).
- Combined share of budget indicated in the measures 'InoclusterLT' (only part of information is available at the moment, because 1st PFSA only covers part of allocated budget) and 'InoConnectLT' has been *reduced* for 'Inclusive and creative society' (10%) and 'Manufacturing

[4] The specific names of the policy instruments are different in some cases. The calculations are based on the author's assumptions as to which instruments in the priority plans correspond to which instruments in the OP for 2014-2020.

processes, technologies and materials' (8%) priority areas, and *increased* for 'Health technologies' (11%) and 'Energy and sustainable development' (9%). This information is not uncontroversial. For example, in the priority roadmaps it was suggested to allocate significant policy attention (and funding) for developing trans-sectoral technology networks related to new manufacturing processes and technologies in the first years of the 2014-2020 period. There is substantial potential in this area related to ICT and engineering fields, however there is little collaboration experience. However, it may be so that the Ministry of Economy found little interest, i.e. little demand to submit proposals from the related sectors.

Finally, there are some risks related to preconditions for successful implementation of the priorities that can neither be confirmed nor rejected at this stage, because the implementation has not yet started:

- **Implementing smart specialisation roadmaps and plans according to their key assumptions would require substantial resources from policy implementing agencies**. Sufficient attention and adequate resources should be granted to effective programme management and careful pipeline development. This has been one of the weakest links in the past period, including the risk-aversion and weak capacities of administration, as well as poor management of programmes. If required resources and procedures are not planned, there is a risk of inertia in implementing the policy mix, ignoring the different maturity of the priorities, leading to lack of focus on the potential and new innovators, and lack of new high quality projects.
- **Similarly, orchestration of policies affecting RDI performance would require strengthened policy coordination processes**. Given the number of funding bodies and programmes, departments and agencies should agree to a coherent and consistent approach to the administration of funding programmes. Hints of related problems are already visible at this stage. **A reoccurring weakness is a lack of synergies and coordination between measures** under objectives 1.1, 1.2.1 and 1.2.2, or between different measures such as 'InoclusterLT', 'Competence centres' and 'InogebLT'. It is clear that the three specific objectives under Thematic Objective 1 are 'vertically focused', i.e. designed according to which ministry is responsible for specific measures. Therefore, some measures of the Ministry of Economy aimed at facilitating technology transfer (e.g. 'InoclusterLT') are placed under objective 1.2.1 and not 1.2.2. On the positive side, attempts to exploit the synergies can be also found, for example:
  - A synergy between measures 'IntellectLT' and 'Joint science-business projects' (the latter is implemented under objective 1.2.2).
  - Efforts to ensure that R&D infrastructure already purchased by open access centres or clusters would not be funded again by 'IntellectLT' (even if purchased by a single company) are commendable. This was recommended by experts (e.g. Visionary Analytics, 2014). However, it has to be ensured that such infrastructure becomes available to all interested outside specific R&D centres or clusters.
- **Strengthening of strategic intelligence and monitoring capacities and procedures.** RDI monitoring and analysis of innovation performance in the selected priorities, ex post policy evaluation and foresight capacity need to be increased substantially and assisted by consultations with the main stakeholders and actors in the innovation system. The continuous monitoring of the priorities should be implemented, and assigned institution should coordinate the actions and instruments implemented by numerous policy agencies.

1.3. Objective 1.1. 'Promoting more active use of the existing and new RIs'

Scope

Two measures evaluated under this Objective are listed in a table below. By the time when this report was prepared, only one measure had approved PFSA.

Table 2. Measures under Objective 1.1 of the OP for 2014-2020

Measure	Funding, €m	Project selection method	PFSA is available
'Development of R&D&I infrastructure and its integration into European	€188m	State planning	Two separate PFSAs are approved, covering about 2/3 of planned activities

Measure	Funding, €m	Project selection method	PFSA is available
infrastructures'			under this measure
Development of competence centres	€8.69m	Project competition	No

Source: www.esinvesticijos.lt. NB: Hyperlinks indicate the source of information on each measure.

Gaps in the Lithuanian RDI system: summary of previous expert recommendations

Muscio et al (2015) claim that the CEE innovation systems have reached a ceiling in terms of their capacity to absorb public financial investments in research and innovation, notably due to the limited human and financial capacities of both universities and firms. Hence, pumping more investments into research and innovation infrastructure, may absorb funds, but is unlikely to lead to the expected returns (Muscio et al, 2015). It is no surprise, that previous studies and evaluation reports on further development and use of R&D infrastructures in Lithuania can be summarized into these three sets of re-occurring recommendations:

1. **First, shift from *building new* infrastructures to creating incentives for the *use of existing* ones**. The general policy focus should be moved to 'soft' capacity building and RDI human resource development measures vs. infrastructure investments (Paliokaitė and Kubo, 2013; RIO reports Lithuania, 2013, 2014, 2015; Visionary Analytics, 2014, 2015).
2. **Second, new RDI infrastructure investments limited strictly with the requirement for the actual and strategic RDI collaboration** between research and business community:
   - Giving the preference for those consortia who are able to present longer-term research agenda plan, demonstration of strong industry commitment (incl. co-financing), and having international collaboration dimension integrated into their research strategies (OECD, 2015, 2016; Paliokaitė and Kubo, 2013; RIO reports 2013, 2014).
   - Addressing the challenge of lacking technological development infrastructure and related technological services, as well as specific infrastructure aimed at technology transfer and building science-industry linkages, and meeting necessary preconditions -- high quality research and technological development services, convenient access for clients, involvement of businesses and other key stakeholders in the discussion on the demand for research and technologies to the developed and effective incentives for these infrastructures to become industry demand-oriented) (Paliokaitė and Kubo, 2013). On the other hand, Visionary Analytics (2014) found that actual demand for public 'technological development' infrastructure is low and can only be justified in exceptional cases.
   - Development of public R&D infrastructure should be more clearly linked to the clusters' infrastructure and other related capacity building in specific technological fields (Paliokaitė and Kubo, 2013; Visionary Analytics, 2014, 2015).
   - Rules and criteria for further investments into (international) R&D infrastructures, involvement into international R&D infrastructures (e.g. ESFRI), open use of R&D infrastructures should be established in the national infrastructures roadmaps and should allow for transparent selection of investments (Paliokaitė and Kubo, 2013).
   - Furthermore, OECD (2015, 2016) suggested consolidating the higher education institution landscape, including through possible mergers so that advantages of scale and scope can be achieved. Other countries managed to use public investments as incentives for such consolidation.
3. **Third, use financial incentives for facilitating internationalisation of the R&D system**:
   - Support institutional capacity building at universities and research centres to enhance internationalisation as core element of the institutions' strategies (OECD, 2015, 2016)
   - For Lithuania it is justified to focus its transnational RDI cooperation efforts towards the Baltic Sea Region to amplify the networks and projects already established and make better use of the reinforced framework of the EU's Strategy for the Baltic Sea Region by including respective arrangements into the Operational Programmes (Paliokaitė and Kubo, 2013).
   - The idea of 'parallel labs' (transnational collaboration in exchanging researchers and students and joint research in the laboratories related to similar research fields but located in different countries) is worth pursuing (Paliokaitė and Kubo, 2013).
   - Internationalisation of RDI policy, incl. respective positioning and target setting at the national level is needed to mainstream the transnational collaboration. In line with that all national RDI

measures should include relevant international dimension, stimulate partnerships, open-up for international partners and clusters, etc. Moreover, none of the S3 priority areas should involve purely national agendas.

Assessment

The Objective 1.1. 'Promoting more active use of the existing and new RDI infrastructure' generally responds to some of the above discussed policy gaps. More specifically, it promises to invest into new R&D infrastructures related to R&D commercialisation and technological development linked to industry needs (e.g. competence centres, technology transfer centres etc.), and international R&D infrastructures. However, there is a visible mismatch in terms of creating incentives for more active use of existing R&D infrastructures, programmed already in the description of OP Objective 1.1.

The conclusions below are based on the PFSA of one measure - 'Development of R&D&I infrastructure and its integration into European infrastructures' – which PFSA is available for the assessment.

First, all measures under Objective 1.1 concentrate on further acquisition of new equipment or building/relocation of R&D infrastructures instead of promoting (business) usage of already existing R&D infrastructure:

- It was recommended that investment in new infrastructure would be an exception rather than a rule, and only in those cases, when clear value added of such investment could be demonstrated in relation to increasing research and business cooperation. Currently share of investments into R&D infrastructure under Objective 1.1 (€197m or 31.1% of total investments) is higher than the share for investments into public and public-private R&D projects under Objective 1.2.2 (€156m or 24.6% of total investments).
- Development of specific infrastructures aimed at business-science cooperation and targeted research (competence centres, technology transfer centres) is either not foreseen (no PFSA approved at this stage), or makes up a small share of the total budget allocated for Objective 1.1 (e.g. €8.9m for the development of competence centres vs €188m for the rest of infrastructure development).
- Currently approved project financing conditions cover support for:
  - Creation of STEM centres for secondary education students which is not related to encouraging business to use public R&D infrastructure (key result indicator of Objective 1.1) and is aimed more at making research career attractive rather than developing infrastructure which has research as its main purpose. Thus this activity rather belongs in Thematic objective 9.
  - Development of informational infrastructure for research and higher education (LITNET) which again does not promote business access to research infrastructure.
  - Ensuring access to electronic resources, which does not contribute to business' using research infrastructure acquired during the previous OP 2007-2013, and is more related to general R&D capacity building.
  - Development of the Marine valley, with no measures aimed at encouraging business to use the existing infrastructure, but instead concentrates on further development of the R&D infrastructure.
- Considering sub-measures/projects which are planned under this measure (chapter 1.2), it is clear that most of the funds not yet covered by project financing conditions will be similar to those already defined. That is, they will be more likely to cover acquisition of new equipment or reconstruction than making research infrastructure attractive to businesses.

Second, a number of success preconditions for designing the policy mix under the Objective 1.1 have not been met, for example:

- Selection of activities and projects to be funded under the measure 'Development of R&D&I infrastructure and its integration into European infrastructures' are not sufficiently justified, for example:
  - Several projects planned under the measure 'Development of RI and its integration in the European infrastructures' (E-Lingua, ESS LT, MAO, HUMRE) are only weakly (if at all) linked to the Lithuanian smart specialisation priorities.

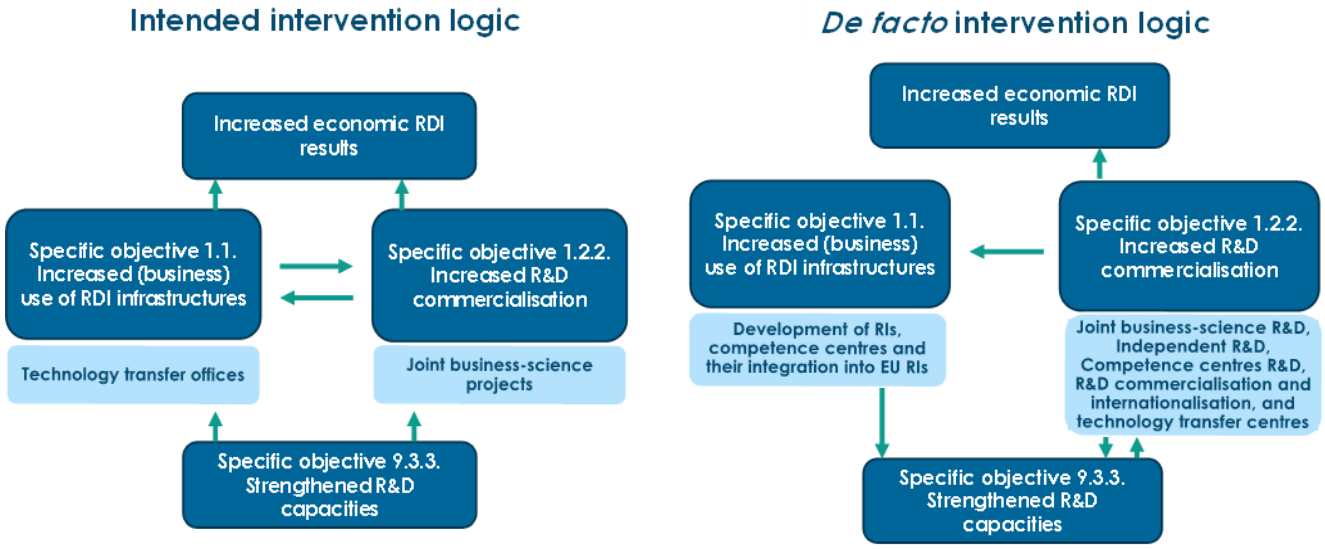
- The specific selection criteria in the PFSA-2[5] are related to the links to smart specialisation priorities. However development of the Marine valley (stage 2) is not directly linked to any of the smart specialisation priorities as already discussed in chapter 1.2.
- It is very important that the project selection criteria for parallel laboratories and European R&D infrastructures are transparent. They are not available for assessment at the moment.

- No clear links to previously created clusters infrastructure, or at least not available at this stage.
- No links to internationalisation strategies or collaborative R&D strategies as criteria for selecting the R&D infrastructure investments. **A positive sign -** applications are evaluated more positively if linked to the BSR strategy or collaboration in the Baltic Sea Region.

For the discussion on compliance to the smart specialisation priority plans see sub-chapter 2.2.

To sum up, **it is unlikely that the planned infrastructure development measures would have a substantial impact on the planned result indicator of the Objective 1.1 – business usage of open access R&D infrastructure (3000 users by 2023).** The *de facto* intervention logic of the Specific Objective is weak (see Figure 1 below) – instead of contributing to active (business) use of RIs, it contributes to the strengthening of public R&D capacities. It is highly doubtful that these investments will be implemented effectively.

Figure 1. Intended and de facto intervention logics of Specific Objectives related to the active use of RDI infrastructures and public RDI resources



Source: prepared by author.

Implementing measures below could strengthen contribution to the target indicator:

- Ensuring that all measures under SO 1.1 and/or their final results are dedicated to active use of RDI infrastructure, by local or foreign business.
- Enabling incentives for the *active use* of existing RDI infrastructures, for example: develop effective technology transfer centres, marketing and collaboration strategies of existing open access RIs, attract high quality researchers from abroad. These enabling incentives can be funded by specific objectives 1.2.2 and 9.3.3 of the OP.
- Using financial incentives for consolidating critical mass around S3 priorities, facilitating strategic collaboration and internationalisation of the RDI system. It means that funding agencies should limit new RDI infrastructure investments strictly to the projects assessed by independent experts in a transparent selection process and meeting the selected criteria such as contribution to S3 priorities and having strategic collaboration and internationalisation strategy.

[5] Covers activities: Marine valley development, Stage 2.

1.4. Objective 1.2.1 'Increasing the intensiveness of private sector RDI activities'

Scope

11 measures evaluated under this Objective are listed in a table below. By the time when this report was prepared, only three measures had approved PFSAs. Therefore, only those measures could be assessed in detail, although draft PFSAs were also reviewed.

Table 3. Measures under Objective 1.2.1 of the OP for 2014-2020

Measure	Funding, €m	Project selection method	PFSA is available
Intellect LT. Joint business-science projects	€139.02m	Project competition	Draft PFSA.
Inovation vouchers	€10.14m	Project competition	Draft PFSA.
Smartinvest LT+	€43.44m[6]	Project competition	Yes, approved.
Inocluster LT	€26.07m	Project competition	Draft PFSA (only for the 1st call, worth €2.9m)
Technoinvest	€17.6m	Financial engineering	Yes. Joint PFSA for measures of priority 1 and 3 (Technoinvest and two priority 3 measures)
Precommercial procurement LT	€29.36m	State planning	Draft PFSA.
Smartinvest LT	€5.8m	State planning	Yes, approved.
Inogeb LT	€8.69m	State planning	Draft PFSA.
SmartPark LT	€13.03m	State planning	Draft PFSA.
InoConnect LT	€13.03m	Continuous selection (liet. *tęstinė projektų atranka*)	No
InoPatent LT	€3.04m	Continuous selection	No

Source: www.esinvesticijos.lt. NB: Hyperlinks indicate the source of information on each measure. Last updated: 20 May 2016.

Gaps in the Lithuanian RDI system: summary of previous expert recommendations

Low business R&D investments can be considered a 'Lithuanian curse'. Business R&D indicators are low compared even to the CEE average, and there is no visible change despite significant investments in this area. There is an explanation for it. Lithuania is a lower/middle income country with specialisation in labour intensive traditional industries, facing the need for upgrading. Much of the manufacturing production is at the low end of advanced manufacturing and global value chains. Another factor is the low share of knowledge-intensive business services in manufacturing intermediate consumption. This undermines the potential to differentiate products and increase value added of the manufacturing sector. The R&D effort is predominantly ensured by the public sector. Private sector, in its current specialisation, does not perceive innovation as a critical factor to long-term competitiveness. The existing target group in Lithuania for the excellence-based competitive R&D measures thus consists of limited number of top-tier research groups and few knowledge-based companies. Raising the business R&D allocations for without simultaneously dealing with the pipeline creation through 'soft' capacity building and one-on-one services provision is doomed to result in absorption problems. Too much focus on science based R&D on the one hand, and lack of focus on business R&D absorptive capacities on the other - created a vicious circle, largely leaving possible newcomers (start-ups, traditional industries) with their development needs out of the scope (Visionary Analytics, 2015).

The problem is not unique at the European level. Widely known 'regional innovation paradox' refers to the apparent contradiction between the comparatively greater need to spend on innovation in lagging regions and their relatively lower capacity to absorb public funds earmarked for the promotion of innovation and to invest in innovation related activities, compared to more advanced regions (Oughton et al., 2002). Muscio et al (2015) provided evidence on existence of this paradox in the CEE countries. Effect of this 'paradox' is strengthened by copy-pasted policies more suitable for higher income countries – innovation leaders. Izsak et al. (2014) found that policy mixes in the EU are highly homogenous despite different needs and levels of technological development. Current policies in the

[6] Based on the approved PFSA. A different figure is indicated in the official website www.esinvesticijos.lt.

CEE are not appropriate to their income levels and distance to technological frontier, and they reflect much more 'the best practice', but not their specific technological positions and constraints. The 2014–2020 period may be a 'make or break' one for Lithuania in terms of achieving significant structural change and breaking out of the 'middle-income trap'. Given the above, the key challenge is to promote the structural change of economy by providing transformation agenda for diversification and transition to new knowledge based activities in all sectors, including traditional ones (instead of focusing on few R&D based innovators).

In mapping the determinants of absorptive capacities in different types of firms, an integrative 'stairway of competence' model is proposed (Table 4), matching four innovator types with tailor-made policy instruments aimed at strengthening their respective capacities. In the proposed model, firms with only basic innovation and absorptive capacities start by strengthening their technological capabilities, upgrading production systems and managerial knowledge, attracting skilled specialists and strengthening cooperation with innovative companies in order to foster technology diffusion.

Table 4. Challenges and needs of different innovator types

	Technology consumers	Potential innovators	Emerging innovators	Mature innovators
Typical firms	• Manufacturing companies and services providers (including public sector) that lack modern technological and managerial capacity and productivity.	• Generally large manufacturing companies or services providers in the traditional sectors ('the cornerstones of economy' facing the loss of competitiveness and thus feeling the pressure to move to new business fields and products.	• Generally young and/or small companies, export oriented, fast growing. Include both emerging indigenous companies (start-ups, university spin-offs) and foreign direct investors.	• Generally R&D-based medium-large, long time in the market (+10 years), operating in the high technology sectors, export oriented, having well developed networks with the research institutions and business partners in the country and beyond.
Challenges	• Modernisation and strengthening of technology and absorptive capacities (including the human resources).	• Diversification and technology transfer, new innovative activities and new business models.	• Acceleration of innovative activities, including spin-off creation, attraction of risk capital and other financial resources (incl. FDI) to increase the critical mass, strengthening of capacities (including R&D infrastructure).	• Moving to higher impact innovations, large scale R&D projects, new international markets, spin-outs.
Focus of the policy mix	• Demand-side incentives (innovative public procurement, pre-commercial procurement, other market incentives, e.g. facilitation of ICT in all sectors). • Capacity development (attracting highly qualified specialists, learning, technology upgrading – grants or tax incentives for production of new technology).	• Incentives for transformation (support for networking - technology platforms, clusters, foresight); • Support for experimentation • Various innovation support services encouraging moving to new products and new business models, such as 'soft' idea development support, brokerage, technology services at the science parks; • R&D subcontracts fostering linkages with research institutions, innovation vouchers.	• Start-up acceleration (mentors, seed and risk capital, business plan competitions, prizes for young entrepreneurs, business incubation etc. • Targeted FDI attraction.	• Grants for R&D projects; • Grants for international R&D projects – FP7, Horizon 2020 and other international initiatives; • R&D infrastructure support (for companies, not universities). • Promotion of technology diffusion and transfer from high tech to low tech industries.
Horizontal	Availability of high quality labour force (ensuring high quality of education). Favourable framework conditions (entrepreneurship policies, flexible labour market, tax policy, RDI regulations, talent attraction policies, standardisation, favourable conditions for research careers, etc.)			

Source: Paliokaitė, Martinaitis, Sarpong, 2016; Visionary Analytics, 2014, 2015.

The model assumes that innovation policies should reflect different capabilities and needs of firms (from technology upgrading and imitation to diversification and technology frontier activities), and should take into account various types, forms and sources of knowledge exploited for innovation by all sorts of actors in all economic sectors. This model was proposed by the experts leading methodological discussions on the preparation for the implementation of smart specialisation priorities in Lithuania.

Previous studies and evaluation reports emphasized these key sets of recommendations regarding business innovation measures, that in general reflect a model discussed above:

- **First, establish a more balanced policy mix aimed at extending the number of business R&D and innovation performers**, focusing on newcomers - start-ups, spin-offs, knowledge-based foreign investors, and previously non-innovative 'traditional' companies (Visionary Analytics, Pundzienė, Valinčius et al. 2014; OECD, 2015, 2016; RIO reports 2013-2015; Visionary Analytics 2014, 2015), for example:
  - Introduce or strengthen 'soft' competence building schemes targeted to companies not yet engaged in R&D and innovation, for example in traditional sectors. Deal with the RDI pipeline creation through capacity building and incentives for transformation, such as technology platforms, awareness of international market trends, new emerging technologies, consumers, skills, changing industry structures and business models (foresight), support for experimentation filling the gap between small innovation vouchers and larger R&D grants, hiring of skilled specialists, one-on-one services such as idea facilitation, scouting, mentoring, and matchmaking. To attract currently non-performing but potential innovators, these incentives schemes could be low-barrier, industry and demand driven, and also include non-technological innovation (OECD, 2015, 2016; RIO reports 2013-2015; Visionary Analytics 2014, 2015).
  - Adopt tailor-made approach to the implementation of smart specialisation priorities given their different maturity. This suggests different types of policy interventions, different intended results/outcomes, and different pace ('two-tier' process) (discussed in detail by Visionary Analytics, Paliokaitė, Pundzienė, Valinčius et al. 2014 and Paliokaitė et al., 2016).
  - Focus on full technology development cycle, not just its first stages (RIO reports 2013-2014; Visionary Analytics 2014).
  - Open innovation policies for start-ups and spin-offs through acceleration, mentoring and start-up/seed funding.
  - Implement targeted FDI attraction linked to smart specialisation fields.
- **Second, address development of skilled human resources for RDI as a key emerging bottleneck to RDI development** (OECD, 2016; RIO report, 2015; Visionary Analytics 2014, 2015):
  - Implement business researchers' international training and apprenticeships measures.
  - Encourage foreign researchers and high-level specialist recruitment at the Lithuanian companies, clusters and R&D institutions.
  - Encourage postgraduate student placements in enterprises.
  - Implement Industrial Doctorates programmes.
  - No equipment (public or private) should be purchased without the creation and training of human resources necessary for working with it.
- **Third, develop demand-side policy measures** (Visionary Analytics, Paliokaitė, Pundzienė, Valinčius et al. 2014; OECD, 2016; RIO reports 2013-2015; Visionary Analytics 2014, 2015). The most promising ones might be public procurement of innovation and various types of challenge competitions. The latter may be driven by societal needs, identified international market opportunities or industry needs. International good practices can be used to give direction on how to introduce these across different government bodies and agencies (OECD, 2016).
- **Fourth, develop a long-term strategy for the support of clusters and other collaborative networking arrangements**.
  - Support only those that have real industry involvement/commitment and joint agenda for collaborative research, innovation and/or education (OECD, 2016). A warning sign is that there are now more than 40 clusters. The next period's challenge is thus to create incentives for merging the clusters working in similar technology fields instead of creating new ones (Visionary Analytics, 2014).
  - Review the current existing innovation promotion structures, especially science parks; some clusters can become part of the existing science and technology parks;

    - Connect all open R&D and innovation service infrastructures (including science parks and open access centres) into a virtual network, ensuring synergies and innovation development from idea to market.
- **Fifth, establish a framework for wider national participation in EU level RDI collaboration, extending and strengthening of instruments aimed at international networking** (Paliokaitė, 2015b; OECD, 2016; RIO reports 2013-2015).
    - Further promote the participation into European and other international STI programmes by allocating more resources to private companies.
    - Support opportunities and introduce incentives for international collaboration and into selected R&D and innovation support schemes, in particular aimed at R&D and innovation performers in the business sector.
- **Finally, reduce administrative load** that facilitates the substitution effect (BGI Consulting, 2014; Visionary Analytics, 2014, 2015, among many others).

Assessment

Overall, **the policy mix under the Objective 1.2.1 is more balanced than in the previous programming period**. **It managed to address many of the above-discussed recommendations.** First, the policy mix **builds on a variety of instrument types,** from financial engineering offering risk capital for emerging innovators in the smart specialisation fields to grants and simplified funding instruments such as innovation vouchers. A still high share of grants-based funding (more than 90% of funds of the Objective 1.2.1) is justified due to high risk of R&D investments.

Second, the policy mix is **more balanced in terms of addressed innovator types.** A number of measures address the needs of emerging and potential innovators, or at least are friendlier towards them:

- 'Innovation vouchers' (€10.1m), according to their project selection criteria, prefer companies that have not yet implemented activities financed from national budget or EU funds. In this case emerging and potential innovators have advantage over more experienced innovators. Company establishment criterion (6 months) is rather low, giving opportunity for young companies to apply. There are quotas according to smart specialisation areas.
- 'IntellectLT. Joint projects' (€139m) is open to funding the development of R&D infrastructure of new SMEs, although under existing criteria that include R&D experience and experience in international R&D programmes such as FP7 and Horizon 2020 (thus, preference is given to experienced innovators), spin-offs by mature innovators are more likely than new start-ups.
- 'Technoinvestas' (€17.6m) specifically indicates that it finances firms *including* emerging and young firms, spin-offs, early stage innovating firms and start-ups. However, the PFSA does not specify any preference of emerging innovators over experienced innovators.
- One type of activities financed under 'Inogeb LT' (€8.7m) is 'soft' support for establishing new innovative firms. The measure also provides 'soft' support through consultations and similar measures.

Third, **full innovation/technology development cycle is covered**. Many measures adopt a broad approach to innovation (both product and process innovations are funded). Some measures focus on 'experimental development' that was relatively neglected in the previous period. For example, 'Inovouchers' give preference to last stages of prototype development (stages 6-8 in the technology development scale). This should ensure that all types of innovations at every stage of technology development should find a funding source.

Fourth, **foreign investments are recognised as a viable route** for enhancing the number of existing innovators in a country. FDI attraction measures (Smart Invest, Smart Invest+, SmartParkLT, altogether about €62m including development of industrial parks' infrastructure) target R&D related FDI into smart specialisation areas, both product and organisational innovations, and facilitate science-business R&D subcontracts and partnerships (universities are eligible partners).

Fifth, **demand-side policies are introduced** by implementing a 'Precommercial procurement' measure (about 10% of total funds under Objective 1.2.1). A projects list is not yet available. Anecdotal evidence found in non-credible sources (newspapers, etc.) indicates that the pilot project will be implemented by the State defence ministry in the field of drone technologies. Some success factors for the implementation of this measure were suggested by Visionary Analytics (2014):

- Regulatory measures, for example standards, testing, early stage certification, consumers' protection regulation, bio-safety regulation etc., could also stimulate the market for innovation.
- Good coordination between the interested parties is a necessary precondition for implementing the innovation demand-side measures, for example between the purchasing authorities and the Public Procurement Office.
- Necessary resources have to be allocated to increase the capacities and train potential users of innovation (e.g. responsible agencies and ministries, State companies), using pilot cases, demand surveys etc.

Sixth, there are **new measures addressing R&D internationalisation** (InoConnect LT and InoPatent LT). However their PFSAs are not yet available, so the measures could not be assessed in detail. The focus on internationalisation is also strengthened by giving additional points to projects that are involved in international programmes ('IntellectLT'), international networks ('InoclusterLT'), and have partners in the Baltic Sea Region (BSR) or their project contributes to the BSR Strategy. However, anecdotal evidence (e.g. Paliokaitė, 2015b) shows that the approach based on additional points, when there are a large number of indicators, has not worked in the past.

Seventh, **attempts to support the strongest clusters, facilitate their merging, internationalisation and awareness building regarding future opportunities**, as recommended by experts, are visible in the first PFSA.

- 'Inocluster LT' supports R& long term awareness building (long term strategies, studies, foresight, market analysis, etc.), also marketing, cooperation between members of clusters, integration into international networks, and other activities.
- The measure does not give preference to projects which plan creation of new clusters, of which there already is a high number (e.g. Visionary Analytics, 2015).
- The measure encourages increasing R&D activities and commercialization (through assessing revenues), thus favours projects that promote cluster activity.
- Preference (according to evaluation points awarded) is given to those clusters that are R&D based, have more members, and are involved in International and intersectoral cooperation (clusters which have already joined/committed to join international or those who have research and higher education institutions as their members). Whether these incentives are substantial enough to facilitate merging of similar clusters, remains to be seen. E.g. the criterion evaluating if cluster is involved/committed to get involved in international activities is given a maximum amount of points of 15 out of one hundred, and these points are also combined with involvement of research and higher education institutions in clusters. Thus, it can be argued that strength of incentive for internationalisation is rather limited.

Finally, the **'joint business-science projects' are planned** under the umbrella of 'IntellectLT'. The design of 'IntellectLT' has several strengths:

- Higher funding rate (90%) is given to projects that are implemented in partnership with science and studies institutions, which is a much stronger incentive for collaboration compared to simply awarding higher evaluation points. IPR protection issues in the cases involving science and education institutions are considered in the PFSA.
- Not only private, but also semi-public R&D organisations (except science and education institutions) are eligible for funding. Apparently this opens doors do the participation of many non-private institutions (liet. *viešoji įstaiga*) operating in the 'creative society' field.
- In-kind contribution by science and education institutions is accepted, which is logical, because these institutions have limited own investment funds.
- There are quotas according to smart specialisation areas, with roughly 35% of funds allocated for 'health technologies and biotechnologies' and 25% for 'new manufacturing processes, materials and technologies'. Only projects in the same priority area will compete with each other, which corresponds to previous experts recommendations (e.g. Visionary Analytics et al., 2014).

The remaining gaps in the business RDI policy mix are discussed below. The conclusions are based on the review of existing draft PFSAs. Two out of 11 measures could not be assessed.

Despite new measures directly targeting <u>emerging innovators</u> (e.g. start-ups, spin-offs), it is not fully clear how effective and comprehensive the overall start-up ecosystem will be, if/how the synergies between the financial and 'soft' measures will be ensured.

- On the positive side, a new financial measure 'Technoinvest' will provide risk/seed capital to companies performing R&D in the smart specialisation areas, including start-ups, spin-offs, young companies and emerging companies. The measure will be implemented by a 'fund of funds' together with other financial measures – 'Invest FP' and 'Entrepreneurship FP'. There is limited information about the measure, selection process or criteria for selecting companies.
- Another measure specifically targeting emerging innovators has been confirmed in the Objective 1.2.2 ('Commercialisation and promotion of internationalisation of R&D results', see next sub-chapter). This measure is limited strictly to innovators related to research and higher education institutions. That is, only such institutions or private legal entities which have been established at least partly by research and higher education institution can apply for grants. Therefore, the measure is not accessible to startups or similar companies unrelated to academia. This limits the scope of the measure. Having in mind that there are no alternatives providing grants specifically for startups, there is a gap in the policy mix – emerging innovators not directly related to research and higher education institutions are at a disadvantage.
- One serious potential obstacle can be **lack of 'soft' measures specifically targeting R&D based start-ups, emerging innovators.** Start-ups need one-on-one business acceleration and mentorship systems as opposed to public trainings and awareness raising events (Visionary Analytics, 2015). One type of activities financed under 'Inogeb LT' (€8.7m) is 'soft' support for establishing new innovative firms. It remains to be seen how this will be implemented in practice. It is highly doubtful that 'InogebLT' support will include mentorship system with experienced experts from business. It can only be assumed that 'Technoinvest' might fund project pipeline generated by projects similar to 'Technostart' implemented by MITA. In the previous programming period, 'Incubation of new technology companies' project ('Technostart', €1.35m) generated a pipeline of ideas coming from students or researchers, which were evaluated by expert teams, and small-scale acceleration support was provided to the best ideas. The most promising ideas were channelled to other support and funding providers – Startup.lt or venture capital funds. The project selected 100 technology ideas suitable for commercialisation, established 45 new technology companies, and provided expert consultations to 45 SMEs. There were plans to continue these type of projects, and it can be assumed they will be funded by 'InogebLT', although project list is not yet available.
- Another potential obstacle may be the restrictions of investment ceiling. **The €17.6m fund is rather small for a seven-year period**, **hence a low ceiling for investment per SME can be expected**. This was already a problem for SMEs using venture capital funds in the previous period. Higher than available investments are needed at both *early stage investment* (maximum seed capital investment was €0.2m), and *scaling up* phase (Visionary Analytics, 2015; BGI Consulting, 2014). As a result, first, majority of venture capital investments in Lithuania are made in the ICT sector as it does not require capital-intensive investments in the early stages of business growth. Second, export-oriented start-ups start looking for other funding opportunities at their scaling up phase and end up moving their business to other countries with more thriving financial markets.
- As in the previous period, emerging innovators face disadvantages due to the way points are awarded in majority of grants-based measures. It is unlikely that under such conditions emerging innovators will be able to successfully compete for funding. Therefore, it is important to solve issues related to the start-up ecosystem discussed above.

The new policy mix is much friendlier to 'potential' innovators, but preconditions for building a pro-active support ecosystem may be lacking.

- Many recent evaluation studies and reports noted the lack of 'soft' support for innovation (brokering, matchmaking, pro-active awareness raising between non-innovative companies, other one-on-one consulting) in Lithuania. Such innovation promotion services will only be funded through 'InogebLT' projects pipeline, facilitated and approved by the State. Eligible activities include technological and non-technological services such as support for clusters, internationalisation activities (partner search and support to for international R&D programmes' applications), idea assessment and development, support for development of precommercial procurement projects, facilitation of start-ups and awareness raising on the benefits of innovation and science progress. Another advantage - most of funds will be allocated for provision of services (covering employee costs etc.). Only up to 10% of funds can be used for infrastructure development.
- However, **share of budget allocated for these services is very limited** (less than 3% of total funds under Objective 1.2.1). These funds will be split between projects targeting four different groups: 1)

start-ups and other emerging innovators - entrepreneurs, students, 2) clusters, 3) innovators writing project applications for Horizon 2020, 4) everyone else including potential innovators.

- There are restrictions concerning eligibility of institutions implementing 'InogebLT' projects. First, MITA is the only eligible applicant. Second, only State co-owned innovation support institutions and business associations (incl. industry chambers) are eligible partners. In this way other science parks (e.g. Technopolis' science park in Kaunas) are excluded. There are also qualification requirements for experts of innovation support institutions (excluding business associations). Third, **only employees are considered eligible experts**. This approach is not uncontroversial. One can argue that introduction of the 'State planning' and MITA as a coordinator shows systemic attempts to coordinate the existing innovation promotion infrastructure, and eliminate some of the 'walking dead' (unsustainable science parks). It could also be argued that the State is trying to channel limited funds to State owned 'walking dead' instead of funding viable innovation promotion infrastructures not owned by the State (e.g. Technopolis' science park's case). More importantly, it is doubtful that MITA and the remaining science parks will manage to employ high quality experts with such relatively small share of funds in such a short time. Good practice foreign examples are either related to a) strong well-funded and well-employed public innovation support institutions such as Sitra in Finland, or b) implementing a system of voucher-based support for a pool of experts from both public and private sectors, or c) a mix of both.
- In summary, it is doubtful that high quality innovation support services will be available for facilitating a large pipeline of good quality potential innovation ideas. Information on what innovation support services will be available for SMEs and how they will be implemented is very limited. At least proper results-oriented incentives are created by the indicators of this measure, such as 'funded international applications', 'technology transfer contracts', 'implemented innovations' etc., and not process-oriented outputs such as 'consulted companies', 'No of seminars' or similar.

Measures supporting R&D human resource development and addressing skills supply and demand mismatches were not assessed in this report. A few related measures are available under the Thematic Objective 9 of the OP. To our best knowledge, **funding of industrial doctorates are not planned** in Lithuania, despite experts' recommendations.

Finally, **there is a gap** between 'InovouchersLT' addressing the prototype development needs of emerging and potential innovators (maximum funding €6000) and 'Intellect LT' addressing the needs of more mature innovators (minimum funding of €50,000). Previously Lithuanian ICT companies complained that this gap is a significant obstacle for development of potential ideas of those companies that cannot implement large scale projects due to co-funding issues, and 'voucher' support is not sufficient for testing specific technologies. This issue could be solved by increasing the maximum support allocated by one 'innovation voucher'.

1.5. Objective 1.2.2. 'Increasing the extent of knowledge commercialisation and technology transfer'

Scope

Five measures under this Objective are listed in a table below. By the time when this report was prepared, none of them had approved project selection and funding guides. Therefore, detailed assessment was not possible, although draft PFSAs of four measures were reviewed.

Table 5. Measures under Objective 1.2.2 of the OP for 2014-2020

Measure	Funding, €m	Project selection method	PFSA is available
Purposive R&D in the smart specialisation fields	€44.89m	Project competition	No
Joint science-business projects	€35.9m	Project competition	Draft PFSA.
Independent R&D projects	€35.92m	Project competition	Draft PFSA (€17.96m)
Facilitation of activity of Competences centres and Technology transfer centres	€26.07m	Project competition	Draft PFSA (€11.58m)

Measure	Funding, €m	Project selection method	PFSA is available
Facilitation of R&D results commercialisation and internationalisation	€13.03m	Project competition	Draft PFSA.

Source: www.esinvesticijos.lt. NB: Hyperlinks indicate the source of information (incl. PFSA) on each measure. Budgets indicated on the website and in the draft PFSAs sometimes differ. Last updated on 20 May 2016.

Remaining gaps: summary of previous recommendations

Previous reports have concluded that the 2014-2020 period should focus on exploiting the created public R&D infrastructure for economic results. To achieve this, innovation culture and skills in the Lithuanian universities and institutes need to be urgently developed. Previous studies and evaluation reports emphasized these key sets of recommendations (OECD, 2016; Technopolis Group & Ernst Young, 2014; RIO/Erawatch reports 2013-2015; Visionary Analytics, 2014):

1. **Provide stronger incentives for research organisations to develop more systematic and professional technology transfer structures and activities**. Require universities and other research organisations to develop technology transfer strategies and action plans with sufficiently ambitious objectives and indicators focusing on relevance and impact. Allocate part of basic funding or part of funding from selected schemes (including infrastructure funding) based on the quality of technology transfer strategies and action plans, and later based on achieved results. **The proactive approach** – from 'business should come to us' to 'we should come to them' - needs to be employed.
2. **Update the researchers' career and institutional funding system.** Business and public research sectors collaboration will not work unless the current researchers' career system and public R&D institutional funding mechanism are changed. The current system does not encourage public sector researchers to focus on commercialising R&D results or providing R&D services for businesses. The researcher should be able to choose between two career directions: teaching and performing R&D (with possible division between scientific research and experimental development). The researchers' career rules and performance requirements should be revised accordingly. A similar change should occur throughout the institutional level.
3. **Foster the research management capabilities** of research institutions and of research units to prepare them for international co-operation (e.g. participation in Horizon 2020) and collaboration with the business sector.
4. **Better exploit the existing public R&D services network (open access centres etc.).** In order to achieve economies of scale by using funding of various state institutions, it is advisable to focus on larger collaborative R&D projects rather than small-scale projects. The strongest organisation can become a project leader of such joint project. Institutions should substantially strengthen their human resources. Development of RIs or technology/competence centres should be more clearly linked to the clusters projects and soft measures for networks, RDI collaboration and capacity building.

Assessment

The Objective 1.2.2 seeks to facilitate knowledge commercialisation and technology transfer, and double the indicator of public R&D funded by private companies by 2023. The planned measures are assessed according to the extent of contribution to these aims.

To sum up, **all available measures are more or less focused on exploiting the created R&D infrastructures for higher quality R&D that could produce economic results**. Some strengths:

- Several measures give higher points to projects at the higher level of the technology development scale (e.g. prototype or pilot manufacturing).
- It can be expected that the measures will have a positive effect on the development of IPR rules and strategies at the institutional level - there is a requirement to have approved IPR rules/strategy at the applicant organisation.

However there are also gaps or issues to be addressed:

- **First, only one measure of assessed measures is directly focused on business-science collaboration** – the 'Joint business and science projects' (23% of total funding under Objective 1.2.2). The contribution of other measures is rather indirect. The strategy or criteria concerning developing

technology transfer centres, their activities and approaches is currently not known. The available draft PFSA of measure 'Facilitation of activity of Competences centres and Technology transfer centres' does not cover technology centres. The development of competence centres activities does not cover involvement from business (see below).

- **Second, the budget available for R&D projects under this objective is substantial** (about €156m), especially compared to the previous period. **But it is still lower than the budget available for the R&D infrastructure development** under Objective 1.1(at least €197m). This contradicts previous experts' recommendations to shift from infrastructure building to R&D and human resources.
- **Third, it is unlikely that young researchers or emerging research groups have high chances** to benefit from R&D projects funded by the measures under this Objective. On the one hand, it is logical that the funds dedicated to smart specialisation should focus on the strongest and most experienced research groups in Lithuania. However, it has to be ensured that other measures implemented under other objectives target young researchers.
- **Fourth, no quotas are planned per priority areas.** There is a risk that R&D projects from different priority areas that are defined by different maturity levels, will compete in one pot, contrary to experts recommendations (Visionary Analytics, Pundzienė, Valinčius et al., 2013; Visionary analytics, 2014).

The strengths and weaknesses of separate measures are assessed below. One measure – purposive R&D - could not be assessed because no information was available. It can be assumed that this measure aims at funding R&D according to the demand of public institutions (e.g. ministries, hospitals). A pilot measure is implemented by the Lithuanian Research Council since 2015.

Measure 'Facilitation of R&D results commercialisation and internationalisation' (€10.14m):

- The measure support development and commercialisation of R&D results by science and studies institutions, their researchers and students: creation of spin-offs, and development of R&D results.
- The project selection criteria will eliminate students and young researchers, because projects are evaluated according the qualification of applicants (their scientific degree, e.g. a professor will have higher chances, and experience in business development).
- The measure contributes to one of three Objective 1.2.2 product indicators (No of new companies that received investments), but does not directly contribute to the result indicator.
- Some issues have to be clarified, for example:
  - Budget per one project is too limited for more substantial R&D project (maximum €20,000), and it is not sufficiently clear from the PFSA what costs are eligible.
  - The applicant is obliged to establish a spin-off company, other routes to commercialisation of the created R&D result are not foreseen. However, spin-off companies established by science and studies institutions are also eligible applicants, hence there is a contradiction.
  - It is not clear if/how private research institutes having official status of science and education institution can participate (in this case it should not be required to establish another spin-off). Private research institutes having the status of a science and education institution (for example, UAB Biotechfarma) may be stuck in some kind of 'limbo' because they are also not eligible to participate in the calls of 'Intellect LT'.

Measure 'Facilitation of activity of Competences centres and Technology transfer centres' (€11.58m):

- The description of the available PFSA only covers the activities of competences centres. The funded activities include development of R&D results that could be introduced into the market (commercialised), including experimentation and expert/consulting support for testing R&D ideas of students' or researchers' groups.
- The measure only supports those competence centres that have acquired modern R&D equipment that can be used for developing R&D results up to the prototype stage, and *have used it* for research or students work for at least 2 years. It means that newly developed competence centres (funded from Objective 1.1) would be eliminated, at least from first call, and this support would be mainly used for exploitation of the 'open access centres'. The evaluation criteria focus on the strongest science and studies institutions according to the evaluation results of the Lithuanian research council, and the plans to establish spin-offs and submit patent applications. According to the maximum funding available for one project (€0.5m), it is planned to fund no less than 23 projects.
- Private companies are not eligible partners. It means that business companies could not have any substantial impact on the R&D developed by the competence centres.

- The measure contributes to one of three Objective 1.2.2 product indicators (No of patent applications submitted by science and studies institutions), and does not directly contribute to the result indicator.

Measure 'Independent R&D projects':

- This measure intends to fund large scale (up to €1m) prospective R&D projects (including basic R&D) carried out by science and studies institutions that would contribute significantly to new knowledge or emergence of new R&D, technology or industry fields. R&D in partnership with business is not supported, but collaborations with other science and studies institutions is possible.
- The measure contributes to one of three Objective 1.2.2 product indicators (No of patent applications submitted by science and studies institutions), and does not directly contribute to the result indicator. However, if the project does not intend to produce patent applications, it can submit licence agreements with business institutions.
- Projects are evaluated according to own contribution (highest evaluation points awarded to those applicants that contribute at least 25%); participation in the national and international business and science collaboration projects; and experience with large-scale projects. In theory this should help selecting those research groups that have required experience and knowledge of industry trends.

Measure 'Joint business-science projects' (€17.96m):

- The measure facilitates business and science collaborative R&D projects (from €50,000 to €700,000). It funds similar activities as 'Intellect LT', but only science and studies institutions as well as university hospitals are eligible applicants. Partnership with private organisations is obligatory.
- Another advantage is that participation of foreign partners is not prohibited and some activities can be carried out abroad, but Lithuania must own the final result.
- Some aspects have to be clarified, for example:
  - Applicants must declare that they have not submitted applications to 'Intellect LT'. However, it is not clarified if different parts of a larger-scale collaborative R&D project can be funded by both 'Intellect. Joint business and science projects' (Objective 1.2.1) and 'Business and science projects' (Objective 1.2.2). Using synergies from different sources to fund longer term strategic R&D projects would be recommended.
  - There is a contradiction in the PFSA's points 47 and 51. Point 47 indicates that maximum share of funding is 80% for private companies, and point 51 indicates that it is 70%.
- Overall, project selection criteria are similar/identical to the ones used by the 'Intellect LT'.

The recommendations concerning the intervention logic of this Specific Objective are provided in the Chapter 3. In addition, effective implementation of this Objective will depend on:

- **Effectively strengthened R&D human resources** (SO 9.3.3), for example, by implementing industrial doctorates, attracting young researchers, and attracting RDI human resources from abroad. A key risk is that instruments could be implemented effectively and the open access RIs could not be exploited to their full potential due to the lack of human resources because of:
  a. Lack of qualified R&D project leaders. Majority of experienced researchers are overburdened already: first, according to the current researchers' career system, majority of their time is dedicated to teaching; second, one researcher can only lead one R&D project at a given point of time. Lack of experienced human resources can be solved by loosening current rules of the Lithuanian Research Council discussed above, and attracting researchers from abroad.
  b. Inability to attract PhDs and young researchers. Currently, salaries of young researchers and especially PhDs are at least 4 times below the EU average. Only 8 foreign candidates were accepted to study PhD in Lithuania out of 50 applicants in 2012-2013, and low salary was the main reason behind their decision not to study in Lithuania[7].
- **Updated researchers' career and institutional funding system**. The research career criteria should be focused on high quality R&D. The researcher should be able to choose between two career directions: teaching and performing R&D.

[7] Source: http://www.slideshare.net/aidisstukas/habil-dr-eugenijus-butkus-vu-ar-doktorantra-tik-treia-studij-pakopa

2. SMART SPECIALISATION IMPLEMENTATION PLAN UNDER THE COMPETENCE OF MINISTRY OF EDUCATION AND SCIENCE

This chapter provides an assessment of compliance of the Plan for the implementation of Lithuanian Smart specialisation strategy actions which are under the competence of Ministry of Education and Science, including list of projects, to Smart specialisation priority area action plans.

2.1. Measures under the competence of MoES

Methodology

The following criteria are used for the assessment of the Plan:

- Compliance of measures with the logic of priority implementation roadmaps and plans. Two aspects are taken into account here: a) mentions of similar measures in the priority implementation roadmaps and plans; b) budget allocated per measure is approximately similar to those included in priority plans.
- Compliance of measures with the aims of Smart specialisation and OP for 2014-2020.
- Lack of coverage of specific important areas of R&D and innovation policy.
- Satisfaction of requirements for successful implementation.

General assessment of measures

Firstly, general comments on the policy mix of the Ministry of Education and Science are provided. This assessment is done in the light of the previous recommendations provided by experts and documents pertaining to the development process of the smart specialisation strategy. Some aspects are similar to the ones already discussed in Chapters 1. Therefore they are only briefly covered.

Despite previous recommendations, still the approach to infrastructure development concentrates too heavily on R&D infrastructure development. OP 2007-2013 saw significant investment in 'hard' measures already, and experts agree that now the more important task is to promote use of what is already available rather than further expand research infrastructure, and develop human resources able to work with this infrastructure.

- Measures falling under the 4th objective (to concentrate and renew studies and R&D infrastructure, to enable its use in implementation of RDI priorities) are allocated €229m of SF funds in total (both for physical and e-infrastructure). Meanwhile, three other objectives are allocated only €216.3m from the EU funds. Resources from the national budget are higher (€876.4m), but 92.9% of those come from measures 1.1 and 2.1 which are not linked directly to OP 2014-2020.
- In addition, there is a risk that acquired or renewed infrastructure will not have significant impact on the challenges faced by the Lithuanian research and innovation system. Otherwise, there is no particular interest on behalf of the state to acquire new equipment, as value added would be low. As Paliokaitė and Kubo (2013) indicate, only those R&D infrastructure projects which manage to clearly demonstrate their importance in increasing collaboration between research and business should be funded, and only if they have long-term agendas. This suggestion is not always satisfied. Appropriateness of specific measures and projects from this perspective are evaluated at later sections of this chapter.

Funding for several measures has changed significantly in comparison to the priority action plans. Some of these changes can have positive, and some – negative effects on building researchers' competences for participating in international research programmes, commercialisation and knowledge transfer. Lithuania faces challenges in all these areas.

- The budget of measure 'Financing of the first and the second stage, integral and non-degree studies' is now more than three times higher than provided in the priority action plans. It can only be assumed that part of this measure would be dedicated to the study programmes other than related to Lithuanian smart specialisation.
- Funds for measures 'R&D projects adding to the implementation of Smart specialisation priorities' and 'Joint research-business projects adding to the implementation of Smart specialisation priorities' have been increased by 23.8%. It could be seen as a positive change, however the budget of the related OP measure does not reflect this change (see Chapter 1).

- Measures 'Support for commercialisation and internationalisation of R&D activities' and 'Strengthening of scientists and other researchers' capabilities in R&D result commercialisation, knowledge, innovation and technology transfer, R&D branding marketing' were allocated only 43.9% of the funds indicated in the Smart specialisation priority action plans. This means that attention to developing capacities of researchers to take a step from research to innovation has been decreased, keeping in mind that this was seen as most crucial aspect for successful development of the Lithuanian research system by experts.
- Measure 'Strengthening scientists and other researchers' capacities to participate in international research programmes' was decreased by 72.6%. This change decreases the likelihood of successful participation in international research programmes, such as Horizon 2020, especially keeping in mind that Lithuania was one of the lagging countries in FP7 (European Commission, 2016).

Several areas that were identified in the priority roadmaps as important and belonging to the competence of the Ministry of Education and Science are not covered by the policy mix or are given little attention.

- Mobility of researchers – two measures (1.4 and 1.5) are related to this issue, but none cover outward mobility with requirement to return to Lithuania after a certain amount of time spent abroad.
- Industrial doctorate plays only a small role in the policy mix of the Ministry of Education and Science, although it was recommended by the experts (Visionary Analytics, 2014).
- Entrepreneurial education does not have a special role in the policy mix. While the concept of entrepreneurship is mentioned several times in the context of R&D commercialisation, there are no horizontal measures aiming at entrepreneurial education for students, including at the doctoral level, which would enable them to market research more easily and also help generating ideas for knowledge-intensive business.

Assessment of specific measures

Individual measures are assessed in terms of:

- Importance for overcoming challenges faced by the Lithuanian research and innovation system;
- Links to OP thematic objectives 1 and 9 and corresponding result indicators;
- Contribution to S3 priorities and connections with priority action plans / S3 development reports;
- Horizontality of the measure, i.e. it is assessed whether the measure: a) covers only specific S3 priorities; b) covers all / the majority of S3 priorities; c) has broader scope than S3 priorities.

Table 6 presents an assessment of all measures included in the policy mix of the Ministry of Education and Science. The more detailed assessment of measures which are not considered as appropriate for the smart specialisation strategy follows below.

Table 6. Assessment of measures included in the policy mix of the Ministry of Education and Science

Measure indicated in the MoES Plan on the Implementation of Smart Specialisation	Justified according to LT innovation system gaps as indicated in the expert reports[8]	Contributes directly to S3 priorities and was indicated in the S3 priority reports/plans	Direct link to the OP thematic objective 1 and its result indicators	Horizontal measure (relevant for implementation of all S3 priorities)
1.1 'Financing of the first and the second stage, integral and non-degree studies'	Partly – the instrument that supports the higher education system, which would have been implemented with or without S3	Partly – no direct link to S3, but included in priority action plans	No, it is not a part of OP 2014-2020	Yes
1.2 'Implementation of higher education study programmes in Smart specialisation priority areas'	Yes – strengthening human capital in S3 priorities	Yes	No – measure is a part of thematic objective 9	No, specific to S3 priorities
1.3 'Financing and development of doctoral studies (attracting youth from abroad)'	Yes – increasing number of graduates and doctoral students	Yes	No – measure is a part of thematic objective 9	No, specific to S3 priorities
1.4 'Attracting foreign scientists and R&D activities'	Yes – strengthening human capital in research, increasing inward mobility	Yes	Partly – lack of link with results indicators	No, specific to S3 priorities
1.5 'Attraction and reintegration of 'brains''	Yes – strengthening human capital in research, increasing inward mobility	Yes	No – measure is a part of thematic objective 9	Yes
1.6 'Promotion of postdoctoral training'	Yes – strengthening human capital in research by supporting young researchers	Yes	No – measure is a part of thematic objective 9, lacks links with result indicator	Yes
1.7 'Developing capacities of scientists and other researchers to participate in international research programmes'	Yes – increasing capacities of researchers to participate in international programmes	Yes, but funding was significantly reduced	No – measure is a part of thematic objective 9	Yes
1.8 'Increasing qualifications of researchers and scientists in knowledge-intensive enterprises'	Yes – increasing capacities of researchers and increasing research capacities of SMEs, commercialisation of R&D results	Yes	No – measure is a part of thematic objective 9, lacks links with result indicator	Yes
2.1 'Ensuring financing of highest level R&D activities for solving important strategic problems faced by the state and the society, and promoting economic development'	Yes – contributions to overcoming societal challenges	No direct link to S3, funds are allocated to national programmes unrelated to S3. However, it is included in priorities action plans	No, it is not a part of OP 2014-2020	Yes
2.2 'Research carried out by high level groups of researchers'	Partly – no specific gap addressed, since measure addresses fundamental research, but necessary for development of S3 priority areas	Linked to S3, but unclear relationship to priority action plans	Yes	No, specific to S3 priorities
2.3 'Implementation of R&D projects which contribute to the implementation of smart specialisation strategy's priorities'	Yes - connecting research actors to the economy, paying more attention to societal challenges	Yes	Yes	No, specific to S3 priorities
2.4 'Implementation of joint science-business projects which contribute to the implementation of smart specialisation strategy's priorities'	Yes – increasing cooperation between research and businesses, employing research infrastructure	Yes	Yes	No, specific to S3 priorities
2.5 'Implementation of market-oriented joint science-business projects through international network'	Yes – increasing cooperation between research and businesses, employing research infrastructure, increasing market orientation of research	Yes	Yes	No, specific to S3 priorities
2.6 'Activities of parallel laboratories'	Yes – internationalisation of research	Yes	Yes	Specific to two S3 priorities in 'Health technologies and biotechnologies' area
2.7 'Increasing qualification of high-level scientists in excellence centres'	Yes –increasing capacities of researchers	Partly – not included in priority action plans	No – measure is a part of thematic objective 9	Scope is not clear
2.8 'Risk capital for R&D and innovation activities'	Yes – lowers dependence on public funds, promotes	Partly – not included in	Yes	Scope is not clear

[8] For example: OECD (2016), Paliokaitė (2015), Paliokaitė and Kubo (2013)

Measure indicated in the MoES Plan on the Implementation of Smart Specialisation	Justified according to LT innovation system gaps as indicated in the expert reports[8]	Contributes directly to S3 priorities and was indicated in the S3 priority reports/plans	Direct link to the OP thematic objective 1 and its result indicators	Horizontal measure (relevant for implementation of all S3 priorities)
	RDI in the private sector and research-business cooperation	priority action plans		
3.1 'Commercialisation and promotion of internationalisation of R&D results'	Yes – increasing commercialisation of public research results and increasing internationalisation of research	Yes	Yes	No, specific to S3 priorities
3.2 'Strengthening capacities of researchers to commercialise R&D results, knowledge, innovation and technology transfer and R&D branding'	Yes – increasing capacities of researchers, including capabilities to commercialise research, promoting knowledge and technology transfer	Related to S3, but unclear place in priority action plans	No – measure is a part of thematic objective 9	Yes
3.3 'Promotion of activities of innovation and technology transfer centres'	Yes – promoting technology transfer	Yes	Yes	No, specific to S3 priorities
3.4 'Promotion of activities of competence centres'	Yes – increasing research-business cooperation	Yes	Yes	No, specific to S3 priorities
4.1 'Development of information infrastructure for research and studies'	Partly – there already is new infrastructure, thus any further acquisitions or developments should have clear impacts on research and innovation system	Indirectly	Yes	Yes
4.2 'Creation of infrastructure for science popularisation'	No	No, although included in S3 priorities action plans	No – would be better under other objectives	Yes
4.3 'Creation of science, technology, engineering and mathematics open access centres for students in secondary education'	No	No, although included in S3 priorities action plans	No – would be better under other objectives	Yes
4.4 'Creation of infrastructure for excellence and parallel laboratories'	Partly – similar to 4.1	Yes	Yes	Specific to S3 priorities, although the extent to which they will be covered is unclear
4.5 'Creation and development of international research infrastructures and Lithuania's integration into them'	Mostly – increasing research internationalisation, however there already is new infrastructure, thus any further acquisitions or developments should have clear impacts on research and innovation system	Yes	Yes	No, specific to S3 priorities
4.6 'Renewal of smart specialisation priorities-related equipment used in open access centres'	Partly – similar to 4.1	Yes	Yes	No, specific to S3 priorities
4.7 'Renewal of R&D&I and higher education infrastructure related to smart specialisation priorities'	Partly – similar to 4.1	No – although it is suggested that projects will be related to S3, the links are indirect at best	Yes	In theory it is specific to S3 priorities, but also covers unrelated fields
4.8 'Concentration of research and higher education infrastructure, modernisation of teaching and learning environment'	Partly – similar to 4.1	No, the links are indirect at best	No – measure is a part of thematic objective 9	
4.9 'Implementation of the second stage of the creation of the kernel of Marine valley and renewal of studies infrastructure'	No – there already is new infrastructure and the significant impact of this measure on overcoming current gaps is not demonstrated	No	Yes	No
4.10 'Development of competence centres' infrastructure'	Partly – similar to 4.1	Yes	Yes	No, specific to S3 priorities
4.11 'Subscription to databases required for R&D and innovation activities'	Partly – although measure does not address any specific gap, it is required to ensure successful implementation of research activities	Partly	Yes	Yes

Source: prepared by the authors.
NB: Green means full compliance ('yes'), yellow – some compliance ('partly' or 'unclear'), and red means lack of compliance to a specific indicator.

Measure 1.4 belongs to thematic objective 1 of the OP 2014-2020, however it lacks direct links with its indicators. This measure addresses an important issue – lack of international mobility of scientists, and aims at increasing the number of incoming mobilities. However, specific objective 1.2.2 does not include mobility measures. There is a lack of direct connection with indicators of specific objective 1.2.2. The result indicator measures the share of R&D in HEI that was financed by businesses. In summary, this measure belong in the thematic objective 9.

Measure 1.7 has undergone reduction of funds which diminishes the likelihood that participation of Lithuanian researchers in international research programmes will increase. This measure contributes to developing researchers' capacities to participate in international research programmes, such as Horizon 2020. This could be a very important contribution to strengthening Lithuanian research. Compared to priority action plans, this measure suffered reduction of funds by 72.6%. This may prevent achieving the intended results. Importance of similar measures was consistently stressed both in reports on research in Lithuania and during the creation of Lithuania's smart specialisation strategy. Experts indicate that low participation in international programmes is a weakness of the research system, and increasing it provides new opportunities for internationalisation (Paliokaitė 2015b, OECD 2015, 2016). Therefore, reduced funding to this measure negatively affects the expected outcomes.

Measure 2.7 was not included in S3 priorities action plans initially, but contributes to S3 goals. This measure aims at increasing competences of researchers in excellence centres. Increasing of qualification of researchers has been widely seen as important for developing Lithuania's research and innovation system. Since measure is related to thematic objective 9 of the OP 2014-2020, it is broader than S3 priorities, but can provide important support for the implementation of S3.

Measure 2.8 is more closely related to providing risk capital for RDI activities, and therefore could be more suitable for the policy mix of the Ministry of the Economy. This measure was not included in priorities action plans. It addresses an important issue of low private investment in R&D and instead of providing one-time investment, aims at starting a cycle of investments re-funded by the private sector, which means that dependence on public or EU funds would be diminished. This a measure appropriate for S3 implementation and addresses challenged faced by Lithuania. It is however not clear how specifically the measure will be implemented and how will HEIs get involved in it. Unless clearer explanation on involvement of HEIs is provided, no direct connection to the area of competence of the Ministry of Education and Science can be identified.

Measures 4.2 and 4.3 are important for future development of the research system, but they do not contribute directly to S3 despite being included under specific objective 1.1.1 of the OP 2014-2020 and would be more suitable under thematic objective 9. Keeping in mind the low number of youth choosing the path of a researcher, there is no doubt that the overall challenge of making research an attractive career choice is an important one. However:

- First, it is doubtful that they belong to thematic objective 1 of the OP 2014-2020. Measures are horizontal and not limited by the S3 priorities. They also do not contribute directly to the key result indicators of thematic objective 1. Since the infrastructure will be used for science popularisation instead of actual research, it can only serve for the dissemination of knowledge about the programme rather than actually carrying out research. It is highly doubtful that businesses would employ such infrastructure for actual research and innovation activities.
- Second, background reports prepared during the development of the smart specialisation strategy do not indicate specific measures for science popularisation. Even if it is stressed that the main attention would be paid to smart specialisation priority areas, this infrastructural investment would not contribute to the goals of priority action plans. Although, measure 4.2 is connected to the objective 'to strengthen capacities to create and commercialise knowledge in research and higher education institutions and other subjects in public and private sectors, and to prepare research and innovation management specialists', it is not clear what the actual link is. Hence, it does not fit within the framework of smart specialisation.
- Third, although description of measure 4.3 indicates that it is directly linked with the priority 'Modern self-development technologies and processes', it is not clear what research activities would be carried out and how funds would be allocated between research and teaching.

Respective priority action plan only indicate such kind of infrastructure once and it is not included in the list of measures, unless it is assumed to be under 'Creation of infrastructure for science popularisation'.

- Fourth, in priority action plans indicators used for these measures are 'the number of researchers working with improved research infrastructure' and 'the number of spin-offs established in research and higher education institutions', but it is not clear how the measures would actually contribute to these indicators.
- Furthermore, high impact of the planned measures on the overall attractiveness of research careers is doubtful. Attractiveness of the research career is primarily defined by the salaries and other key conditions. One of the reasons why it is difficult to attract more foreign researchers is the low salary if compared to EU15 or advanced countries outside the EU. The MORE2 cross-country report on researcher remuneration found that by 2013 Lithuanian first stage researchers (R1) earned only approximately 15.6% of what first stage researchers (R1) earned in Germany, when measured in 2011 PPP €. Similar differences are found across different groups of researchers as well. In Lithuania PhD stipends were approximately 44.8% of those in Germany but only 19.9% of those in Denmark (Idea Consult et al., 2013). Even within Lithuania salary differences are high. Researchers in the high education sector earn 43% less than researchers in the private sector. It is also one of the reasons for emigration of young researchers (RIO report, 2015). To increase the attractiveness of research careers, the State should review the regulation of research funding and career criteria, instead for investing more funds into new infrastructure.

Measures 4.5, 4.7 and 4.8 are potentially appropriate for the policy mix in general, but since pre-selected projects are funded, each project must be assessed separately, which is done in the following section.

Measure 4.9 is not appropriate for the policy mix due to the low probability that it will play significant role in achieving the goals of S3.

- First, it is not related directly to any smart specialisation priority. Measure 4.9 aims at finishing a project started during the OP 2007-2013, which was not finished due to the financial crisis. The MoES' Plan indicates that three priority areas will benefit from this measure: 'Energy and sustainable environment', 'New production processes, materials and technologies' and 'Transport, logistic and information and communication technologies'. However, neither the priority action plans, nor the background reports prepared by expert groups during the smart specialisation process mention direct relation to the development of marine research infrastructure. In the case of the second and the third priority areas, only briefly mentions of marine research infrastructure are made, but no elaborate explanation of its potential benefits is provided.
- Second, the measure has low probability of successful commercialisation of R&D results, thus it would not contribute to achievement of the result indicator of thematic objective 1. According to Eurostat data, in 2013, only 25 companies were registered as working in the water transportation sector in Lithuania. Therefore, there is only a small number of market players who could be interested in using the infrastructure, having also in mind that competing marine infrastructures are available in the Baltic Sea. Furthermore, the project financing conditions set a threshold of 20% for business funded R&D of total R&D performed within the infrastructure three years after implementation of the project. A low threshold indicates that no significant results are expected from the development of this infrastructure.

Measure 4.10 contributes both to the development and exploitation of competence centres. The latter aspect is seen as especially important, so that acquired infrastructure would be used for R&D that benefits the economy. **This measure leaves a mixed impression**, since:

- First, the definition of 'competence centre' and the approach of the development of such centres (versus 'open access centres') is not sufficiently clear.
- Exploitation of the already existing infrastructure is needed, but further expansion of new infrastructures should be limited strictly to those cases, where value added is clearly demonstrated, for example: close ties to business and clearly expressed demand from business, benefits aimed at business sectors, not specific firms, high level of R&D, focus on

commercialisation of R&D results, clear long term strategies including internationalisation and collaboration with business. etc. Only development of new infrastructures meeting these criteria in the smart specialisation areas could be justified.

- Furthermore, Visionary Analytics (2014) concluded, based on a survey of about 200 manufacturing firms, that there is lack demand for construction of industry-based competence or technology centres in Lithuania. Public infrastructure covering all technology sectors and/or all smart specialisation priorities and all technology readiness levels is not justified in a small country like Lithuania. New infrastructure can only be justified if it is created to provide R&D services for the development of "horizontal" technologies demanded by many different industry sectors. Only then exploitation of the full capacity of such infrastructure could be ensured. Based on the "map" of infrastructures already created and the results of manufacturing companies survey, the development of new R&D infrastructure (technology readiness levels 6 to 9) is mostly justified in the case of the smart specialisation priority "Flexible products development and manufacturing technology systems" (Visionary Analytics, 2014).

As mentioned above, measures 4.5, 4.7 and 4.8 already include pre-selected projects. While the measures themselves can be linked to smart specialisation, it is important to assess whether specific projects also comply with the framework of S3. This is done in the following section.

2.2. Specific projects

Criteria

This sub-chapter provides an assessment whether pre-selected projects under the measures 4.5, 4.7 and 4.8 fit the overall logic of Smart specialisation strategy and OP 2014-2020. Table 7 below indicates whether a specific project satisfies the following criteria:

- Connection to S3 priorities – it is important that projects are directly connected to S3 priorities and can benefit their implementation. This is assessed by a) looking at the descriptions of projects and whether they indicate connections with specific S3 priorities; b) inclusion in relevant background reports on S3 (i.e. suggestions for priorities and priorities' roadmaps).
- Synergies with other infrastructure – newly acquired infrastructure should have potential to be used in the context of already existing infrastructure. It is assessed if such infrastructure already exists and locations are similar, so that they could bring synergies.
- Relevance for business – new infrastructure must be used not only by public HEIs but also by business, so that stronger ties between research and business are established, and R&D results can be commercialized. It is assessed whether infrastructure could be used by firms by looking at background reports on S3.
- Clear effects on research internationalisation – new infrastructure should also have potential to join international infrastructures or be used by foreign research performers. It is assessed whether projects already have plans of internationalisation included.

Table 7. Assessment of projects included in the policy mix of the Ministry of Education and Science

Project	Fits clearly into the S3 priorities / Indicated in the S3 background reports	Synergies with other related infrastructure	There is critical mass of companies that could benefit	Effect on R&D internationalisation
4.5.1'Centre for human biological resources'	Yes	Yes	Yes	Yes
4.5.2 'Research infrastructure for biomedical data collection, standardisation and analysis'	Yes	Yes	Yes	Yes
4.5.3 'Centre for computer, structural and system biology'	Yes	Yes	Yes	Yes
4.5.4 'Research infrastructure with national and international access for high intensity and wide wave spectrum ultrashort laser pulse'	Yes	Yes	Yes	Yes
4.5.5 'Lithuanian humanitarian and social sciences data archive'	Partly – there is a lack of direct connection with S3, although researchers in 'Inclusive and creative society' area may benefit	Yes	Unclear	Yes
4.5.6 'Infrastructure for experimental animals research'	Partly – there is a lack of mentions in reports on S3 of such infrastructure, although benefits to 'Health technologies and biotechnologies' area are possible.	Yes	Unclear	Yes
4.5.7 'Metabolomic ecology research infrastructure'	Partly – metabolomics are only mentioned once in priority action plans	Yes	Unclear	Yes
4.5.8 'Centre for innovative chemistry'	Yes	Yes	Yes	Yes
4.5.9 'Lithuanian GRID effective computation network'	Yes – however it must be mentioned that this project would be horizontal	Yes	Unclear – but important for ensuring research capabilities in general	Yes
4.5.10 'Centre for applied chemistry and biopharmacy'	Yes	Yes	Yes	Yes
4.7.1 'Construction of the laboratories' building for the faculties of Mechanics, Electronics and Transport engineering'	Yes	Yes	Unclear – no clear explanation on sectors/firms that could be involved	No
4.7.2 'Construction of a new building for VU Faculty of Mathematics and Informatics'	Yes	Yes	Unclear (similar to 4.7.1)	No
4.7.3 'Construction of a new building for VU Faculty of Medicine'	Yes	Yes	Unclear (similar to 4.7.1)	No
4.7.4 'Creation of the science base for the Faculty of Nursing'	Yes	Yes	Unclear (similar to 4.7.1)	No
4.7.5 'Centre for new medias, technologies and design (M-LAB) (I stage)'	Yes	Yes	Unclear (similar to 4.7.1)	No
4.7.6 'Renewal of infrastructure of the Food Institute and the Faculty of Chemical Technology'	Yes	Yes	Unclear (similar to 4.7.1)	No
4.7.7 'Improving studying environment by developing technological-informational equipment in the Lithuanian University of Educational Sciences'	No – the project aims at improving a library which does not clearly fit into S3 priorities and it is not clear what benefits for research it would bring	No	No	No
4.7.8 'Reconstruction of ASU building no. 4E2p (Studentų street 9, Akademija, Kaunas region) (I stage)'	Yes, but the value added of this project for implementation of S3 priorities is doubtful	Partly – only small No of researchers would benefit	Unclear (similar to 4.7.1)	No
4.8.1 'Building student campus for the Lithuanian Academy of Music and Theatre in Olandų street, Vilnius (I stage)'	No	Unclear	No	No
4.8.2 'Development of internationalisation by adapting infrastructure of the multifunctional centre of Vytautas Magnus University'	No	Unclear	No	No
4.8.3 'Humanitarian sciences campus'	No	Unclear	No	No
4.8.4 'Creation of the study base for the Faculty of Nursing'	Partly – this infrastructure is connected to project 4.7.4	Yes	No	No
4.8.5 'Modernisation of studies infrastructure in the Faculty of Kaunas of the Vilnius Academy of Arts'	No	Unclear	No	No
4.8.6 'Establishment of the R&D and studies centre of the Lithuanian Sports University at Birutės street 19, Birštonas'	No	Unclear	No	No
4.8.7 'Major repair of the First House of the Šiauliai University (P.Višinskio street 25)'	No	Unclear	No	No

Projects 4.5.5, 4.5.6 and 4.5.7 are weakly linked to S3 priorities. Although there are indications in the Plan as to which S3 priority they belong, it is not clear what their specific value for the priorities would be.

- Projects 4.5.5, 4.5.6 and 4.5.7 aim at developing research infrastructure, with specific plans for integration into international infrastructures, which correspond to those identified in the respective roadmap on Lithuanian research infrastructure. Internationalisation is important for Lithuanian research and innovation system. Therefore, the goals of the projects are in line with recommendations for research in general.
- Project 4.5.5 does not have a clear link to S3 priorities, and reports on suggestions as well as roadmaps of S3 priorities do not specifically indicate the need for a national data archive of humanitarian and social sciences. At the same time, probability of business using such infrastructure is low.
- Project 4.5.6 is only weakly linked to S3 priorities, as there were no indications in reports on suggestions and roadmaps of S3 priorities that experimental animals research infrastructure is a priority. Accordingly, it is difficult to assess commercial potential of the equipment planned to be acquired.
- Project 4.5.7 is weakly linked to S3 priorities, as metabolomics is mentioned only once in S3 priorities action plans and once in the roadmaps of these priorities. There are no clear indications of companies that could benefit from such infrastructure.

Projects 4.7.1-4.7.8 do not contribute directly to overcoming the most important challenges for the Lithuanian RDI policy. Instead, these projects will concentrate research infrastructures thematically or renew buildings/equipment. While they are linked to specific priorities, actual value added is likely to be lower.

- Projects under measure 4.7 aim either at increasing concentration of research infrastructures or renewal of specific buildings. Since OP 2007-2013 already invested significantly in the development of infrastructure, current use of similar 'hard' measures should be well supported.
- Projects 4.7.1-4.7.6 have potential in synergies with existing research infrastructures, especially where increase in concentration of infrastructure is planned.
- Projects 4.7.1-4.7.8 do not satisfy such conditions of success as clearly demonstrated plans to cooperate with business, develop internationalisation.

Project 4.7.7 does not fit in the policy framework for S3 implementation.

- The impact of this project on the challenges which are faced by the Lithuanian research and innovation system was not identified. There are no indications that research activities related to S3 priorities would benefit from creation of a library in a new building. Added value of the project is likely to be negligible.
- Supposedly, project 4.7.7 should contribute to the implementation of priorities under area 'Inclusive and creative society'. Although it is foreseen that multifunctional infrastructure is needed in this priority, project 4.7.7 lacks this feature. It is clear, that library will function as a space for studies and review of research results, but it no significant value for R&D activities is expected.
- There are no indications provided about the potential to attract business companies to use the infrastructure. This shows that there are no expectations of collaboration with business, and the commercialisation of the planned infrastructure is not likely.
- There is no information provided about synergies with other existing infrastructures. The project is focused on construction of a library, hence it is not likely that significant synergies will form.

Project 4.7.8 does not fit in the policy framework for S3 implementation.

- There are no clear challenges that Lithuanian research and innovation system faces, which would be tackled by project 4.7.8.
- The guidelines for smart specialisation produced by the EC and the methodology for S3 priorities in Lithuania have specifically indicated that investments should concentrate in those fields where there is already a critical mass of research groups. However, the project description itself indicates that number of researchers who would be affected by renewal of this infrastructure is low. Although it is claimed that new infrastructure could increase the attraction of such researchers, no supporting data is provided.
- Description of the project is too general and it does not indicate whether infrastructure listed in the relevant priority implementation roadmaps will be included in the project. If such is the case, then it is not likely that the project will contribute significantly to achieving goals of smart specialization.
- Potential for commercialisation of this infrastructure is unclear.

Projects 4.8.1-4.8.7 lack direct links to S3 priorities, but are more horizontal.

- Projects under measure 4.8 all belong to thematic objective 9 of the OP 2014-2020. Therefore, it is expected that they are more horizontal and focus not only on S3 priorities but cover other areas as well.
- Nonetheless, there is a lack of direct links with S3 priorities, with an exception of project 4.8.4 which is linked to project 4.8.7. Projects 4.8.2 and 4.8.3 do not self-identify with specific S3 priorities.
- Projects 4.8.1-4.8.7 are mostly linked to renewing studies equipment instead of research infrastructures. If there were clear links with S3 priorities, then these projects would add to increasing human capital within S3 context. However, now such impact will not be high.

Project 4.8.6 does not fit the S3 policy framework or S3 priorities.

- Reports on smart specialisation priorities or their roadmaps only give a small role for sports-related research, with a few passing mentions of sport medicine, diet and equipment. No specific infrastructure for sport research is foreseen.
- Project 4.8.6 finds itself in the priority area 'Health technologies and biotechnologies', but the links are spurious at best, since the argument is that researchers of the university are capable of implementing required research. It is not clear what additional benefits this infrastructure will bring.
- Priorities roadmap did not foresee empirical research on sportsmen, which is the main aim of this R&D and studies centre.
- There is no concentration of infrastructure, it is rather dispersal, since the infrastructure is planned to be established in a different geographic location than the one where LSU is established. Therefore, synergies with other infrastructures will be lowered if this project is implemented.

3. CONCLUSIONS AND RECOMMENDATIONS

Lithuania has come a long way in designing its smart specialisation strategy. First, the country has approved not just the all-inclusive six priority fields, but also came up with more specific priorities (specialisations) within those broad fields. Second, the smart specialisation priorities as well as their implementation roadmaps (including interim and final targets, technologies and products that could be developed, and policy mixes tailored for the specific challenges of each priority) were designed in a broad consultation process with the community of business and science. Third, these roadmaps became the basis for smart specialisation priorities' action plans (20 in total) approved by the two ministers. Finally, by May 2016, Lithuanian policy makers – the ministries of Economy and Education and Science – designed policy instruments to be funded from the EU structural funds, and announced some of the pre-selected infrastructure projects. The task of this report is to assess how well the design of this policy mix matches the smart specialisation outputs (priorities, their roadmaps and action plans).

This chapter provides preliminary conclusions on how the 2014-2020 RDI policy measures, projects and selection criteria comply and contribute to the smart specialisation priorities' action plans. Most focus is given to the measures and pre-selected projects of the Thematic Objective 1. The policy mix is also assessed against the reoccurring experts' recommendations regarding remaining gaps in the national RDI system. It is worth noting that detailed information on about 1/3 of the measures was not available for assessment. Overall assessment is provided in Table 8 below.

Table 8. Assessment of compliance to the OP intervention logic and S3 priority action plans

Assessed measures and projects	Meets the OP intervention logic and gaps in the national innovation system	Meets the smart specialisation action plans and roadmaps
Specific Objective 1.1. Promoting more active use of the existing and new RDI infrastructure	Low	Medium
Specific Objective 1.2.1 Increasing private RDI investments	Medium - high	High
Specific Objective 1.2.2. Increasing knowledge commercialisation and technology transfer	Medium	Medium - high
Projects in the General S3 Action Plan under MoES to be funded by Priority Axis 9	Not evaluated under this contract	Low

Source: prepared by authors.

3.1. Assessment of the policy mix against gaps in the innovation system

1. **First and foremost, the policy mix is much more balanced than in the previous programming period**:
   - The RDI policy mix under Thematic Objective 1 builds on a variety of instrument types, from financial engineering offering risk capital for emerging innovators in the smart specialisation fields to grants and simplified funding instruments such as innovation vouchers.
   - The policy mix is more balanced in terms of addressed innovator types. A number of measures (e.g. 'Innovation vouchers', 'Technoinvest LT', 'Commercialisation and promotion of internationalisation of R&D results') address the needs of emerging and potential innovators, or at least are 'friendlier' towards them.
   - Full innovation/technology development cycle is covered by the policy mix. Many measures adopt a broad approach to innovation (both product and process innovations are funded). Some measures focus on 'experimental development' that was relatively neglected in the previous period. This ensures that all types of innovations at every stage of technology development should find a funding source.
   - Foreign investments are recognised as a viable route for enhancing the number of existing innovators in a country (measures SmartInvestLT and SmartnvestLT+).
   - Demand-side innovation policies are introduced by implementing a 'Precommercial procurement' measure (about 10% of total funds under Objective 1.2.1).
   - New measures address R&D internationalisation (InoConnect LT and InoPatent LT). The focus on internationalisation is also strengthened by giving additional points to projects that are involved in international programmes ('IntellectLT'), international networks ('InoclusterLT'), and have partners in the Baltic Sea Region (BSR) or their project contributes to the BSR Strategy. However, anecdotal

evidence shows that the approach based on additional points, when there is high number of other indicators, has not worked in the past.

- Attempts to support the strongest clusters, facilitate their merging, internationalisation and awareness building regarding future opportunities, as recommended by experts, are visible in the first PFSA of 'Intellect LT'.
- The much-debated collaborative R&D projects are finally introduced - 'Joint business-science projects' will build on the synergies between different objectives of the OP.
- The measures of the Ministry of Education and Science are better oriented towards economic R&D results. Several measures give higher points to projects at the higher level of the technology development scale (e.g. prototype or pilot manufacturing). It can be also expected that the measures will have a positive effect on the development of IPR rules and strategies at the institutional level - there is a requirement to have approved IPR rules/strategy at the applicant organisation.
- Public R&D infrastructure investments have considerably decreased – from at least €400m in the previous period to about €200m in the new period.

2. **All measures under Objective 1.1 concentrate on further acquisition of new equipment or building/relocation of R&D infrastructures instead of promoting (business) usage of already existing R&D infrastructure.** Despite overall share of infrastructure investments has shrunk compared to the previous period, it is still higher than the share for investments into public and public-private R&D projects under SO 1.2.2 (€156m or 24.6% of total investments). Overall, i**t is unlikely that planned infrastructure investments would have a substantial impact on the result indicator 'business usage of open access R&D infrastructure'.**
   - Development of specific infrastructures aimed at business-science cooperation and targeted research (competence centres, technology transfer centres) is either not foreseen (no PFSA approved at this stage), or makes up a small share of the total budget allocated for Objective 1.1 (about 5%).
   - A number of measures and activities under SO 1.1 do not contribute to the result indicator:
     - Creation of STEM centres for secondary education students which is not related to encouraging business to use public R&D infrastructure and is aimed more at making research career attractive rather than developing infrastructure which has research as its main purpose. Thus this activity rather belongs in Thematic objective 9.
     - Development of the Marine valley, with no measures aimed at encouraging business to use the existing infrastructure, but instead concentrates on further development of the R&D infrastructure.
     - Development of informational infrastructure for research and higher education (LITNET) which again does not promote business access to research infrastructure.
     - Ensuring access to electronic resources, which does not contribute to business' using research infrastructure acquired during the previous OP 2007-2013, and is more related to general R&D capacity building.

3. **Despite the new measures directly targeting emerging/new innovators (e.g. start-ups, spin-offs), it is not clear how effective and comprehensive the overall start-up ecosystem will be, if/how the synergies between the financial and 'soft' measures will be ensured.**
   - One serious potential obstacle can be lack of 'soft' measures specifically targeting R&D based start-ups, emerging innovators. Start-ups need one-on-one business acceleration and mentorship systems as opposed to public trainings and awareness raising events (Visionary Analytics, 2015). One type of activities financed under 'Inogeb LT' (€8.7m) is 'soft' support for establishing new innovative firms. It remains to be seen how this will be implemented in practice. It is highly doubtful that 'InogebLT' support will include mentorship system with experienced experts from business.
   - Another potential obstacle may be the restrictions of Technoinvest's investment opportunities. The €17.6m fund is rather small for a seven-year period, hence a low ceiling for investment per SME can be expected. This was already a problem for SMEs using venture capital funds in the previous period. Higher than available investments are needed at both *early stage investment* (maximum seed capital investment was €0.2m), and *scaling up* phase (Visionary Analytics, 2015).
   - As in the previous period, emerging innovators (under Objective 1.2.1) and young researchers (under Objective 1.2.2) face disadvantages due to the way points are awarded in majority of grants-based measures (under both Objectives . It is unlikely that under such conditions emerging

innovators will be able to successfully compete for funding. Therefore, it is important to solve issues related to the start-up ecosystem discussed above.

4. **The policy mix is much friendlier to 'potential' innovators from e.g. traditional sectors, but a pro-active 'soft' support ecosystem may be lacking.**
   - Many recent evaluation studies and reports noted the lack of 'soft' support for innovation (brokering, matchmaking, awareness raising between non-innovative companies, other one-on-one consulting etc.) in Lithuania. However, share of budget allocated for these services is very limited (less than 3% of total funds under Objective 1.2.1).
   - It is doubtful that high quality innovation support services will be available for facilitating a large pipeline of good quality potential innovation ideas.

5. **Focus on R&D internationalisation is rather limited in most measures.** In most cases internationalisation is facilitated by giving additional points for projects involved in the Baltic Sea Region's networks, or having previous experience in international R&D programmes. Previous research (e.g. Paliokaitė, 2015b) found that this approach was not very effective in the past. E.g. the criterion evaluating if cluster is involved/committed to get involved in international activities is given a maximum amount of points of 15 out of one hundred, and these points are also combined with involvement of research and higher education institutions in clusters. Thus, it can be argued that strength of incentive for internationalisation is rather limited.

6. **A reoccurring weakness is a lack of synergies and coordination between measures** under objectives 1.1, 1.2.1 and 1.2.2, or between different measures such as 'InoclusterLT', 'Competence centres' and 'InogebLT'. It is clear that the three specific objectives under Thematic Objective 1 are „vertically focused', i.e. designed according to which ministry is responsible for specific measures.

7. **There is a gap** between 'Innovation vouchers' addressing the prototype testing/development needs of emerging and potential innovators (maximum funding €6000) and 'Intellect LT' addressing the needs of more mature innovators (minimum funding of €50,000). Previously Lithuanian ICT companies noted this gap as a significant obstacle for SMEs, because they have limited own sources to co-finance larger projects, but 'voucher' support is not substantial enough for testing specific technologies. This issue could be solved by increasing the maximum support allocated by one 'innovation voucher' to, for example, €20,000.

3.2. Assessment of compliance to the S3 priorities' action plans and roadmaps

On the surface, the policy mix reflects the S3 priority actions plans up to 70-80%. But 'devil is in the details'- deeper assessment revealed several risks that are discussed below.

8. **Some policy measures under the competence of MoES are only indirectly (at best) related to the implementation of smart specialisation priorities, and would be more suitable under other Thematic objectives of the OP:**
   - ***Measures 4.2 'Creation of infrastructure for science popularisation' and 4.3 'Creation of science, technology, engineering and mathematics open access centres for students in secondary education'***[9] are horizontal and not directly linked to any of the S3 priorities. They also do not contribute directly to the key result indicators of thematic objective 1. Since the infrastructure will be used for science popularisation instead of actual R&D, it can only serve for the dissemination of knowledge about the programme rather than actually carrying out research. It is highly doubtful that businesses would employ such infrastructure for actual research and innovation activities. Background reports prepared during the development of the smart specialisation strategy do not indicate specific measures for science popularisation. See sub-chapter 2.1 for more arguments.
   - **Measure *4.9 'Implementation of the second stage of the creation of the kernel of Marine valley and renewal of studies infrastructure'*** is not appropriate for the S3 policy mix due to the low probability that it will play significant role in achieving the goals of S3. First, it is not related directly to any smart specialisation priority. Second, the measure has low probability of successful

[9] See Table 5 for the full list of specific measures in the Plan under the competence of MoES.

commercialisation of R&D results, thus it would not contribute to achievement of the result indicator of thematic objective 1. See sub-chapter 2.1 for more arguments.

- The added value of ***Measure 4.10 'Development of competence centres' infrastructure'*** to smart specialisation and Thematic objective 1 is not sufficiently clear. First, the definition of a 'competence centre' and the approach of the development of such centres (versus 'open access centres') is not clear at this stage. Exploitation of the already existing infrastructure is needed, but further expansion of new infrastructures should be limited strictly to those cases, where value added is clearly demonstrated, for example: close ties to business and clearly expressed demand from business, benefits aimed at business sectors, not specific firms, high level of R&D, focus on commercialisation of R&D results, clear long term strategies including internationalisation and collaboration with business. Only development of new infrastructures meeting these criteria in the smart specialisation areas could be justified. Second, Visionary Analytics (2014) concluded, based on a survey of manufacturing firms and "map" of infrastructures already created (in firms, clusters and open access centres), that there is no demand for industry-based competence or technology centres in Lithuania. The development of new R&D infrastructure (technology readiness levels 6 to 9) may be justified only in the case of the smart specialisation priority "Flexible products development and manufacturing technology systems", which horizontal technologies could be attractive to large variety of sectors (Visionary Analytics, 2014).

9. **Nearly half of infrastructure development projects under measures 4.5-4.7 are weakly linked (or not linked at all) to the implementation of Lithuanian smart specialisation priorities:**
   - *Projects 4.5.5, 4.5.6 and 4.5.7*[10] are weakly linked to S3 priorities. Although there are indications in the Plan as to which S3 priority they belong, it is not clear what their specific value for the priorities would be.
   - *Projects 4.7.1-4.7.8* do not contribute directly to overcoming the most important challenges for the Lithuanian RDI policy. Instead, these projects will concentrate research infrastructures thematically or renew buildings/equipment. While they are linked to specific priorities, actual value added is likely to be lower. Especially:
     - **Project *4.7.7 'Improving studying environment by developing technological-informational equipment in the Lithuanian University of Educational Sciences'*** does not fit in the policy framework for S3 implementation. The impact of this project on the challenges which are faced by the Lithuanian research and innovation system was not identified. There are no indications that research activities related to S3 priorities would benefit from creation of a library in a new building. Added value of the project is likely to be negligible.
     - **Project *4.7.8 'Reconstruction of ASU building no. 4E2p (Studentų street 9, Akademija, Kaunas region) (I stage)'*** does not fit in the policy framework for S3 implementation. Description of the project is too general and it does not indicate whether infrastructure listed in the relevant priority implementation roadmaps will be included in the project. If such is the case, then it is not likely that the project will contribute significantly to achieving goals of smart specialization. Potential for commercialisation of this infrastructure is unclear.
   - *Projects 4.8.1-4.8.7* lack direct links to S3 priorities, and their contribution to the implementation of S3 would be low. These projects are mostly linked to renewing studies equipment instead of research infrastructures. If there were clear links with S3 priorities, then these projects would add to increasing human capital within S3 context. However, now such impact will not be high. Especially, **project *4.8.6 'Establishment of the R&D and studies centre of the Lithuanian Sports University at Birutės street 19, Birštonas'***, which is planned under Thematic objective 1, does not fit the S3 policy framework or S3 priorities. Reports on smart specialisation priorities or their roadmaps only give a small role for sports-related research, with a few passing mentions of sport medicine, diet and equipment. No specific infrastructure for sport research was foreseen.

10. **Funding for several measures has changed significantly in comparison to the priority action plans. Some of these changes can have negative effects on building researchers' competences for participating in international research programmes, commercialisation and knowledge transfer. Lithuania faces challenges in all these areas. Reallocation of funding can be partly justified by introduction of new relevant measures (e.g. focused on FDI). However, the reallocation from SO 1.1 instead would have been even better justified.**

[10] See Table 6 for the full list and names of specific projects in the Plan under the competence of MoES.

- Funding for „joint business-science projects' and „purposive' R&D projects has been substantially reduced (by €35m and €12.3m accordingly[11]).
- Funding for clusters (collaborative RDI platforms development) has been reduced more than twice (by €42m).
- The budget of measure 'Financing of the first and the second stage, integral and non-degree studies' (under Thematic objective 9) is now more than three times higher than provided in the priority action plans. It can only be assumed that part of this measure would be dedicated to the study programmes other than related to Lithuanian smart specialisation.
- Measures 'Support for commercialisation and internationalisation of R&D activities' and 'Strengthening of scientists and other researchers' capabilities in R&D result commercialisation, knowledge, innovation and technology transfer, R&D branding marketing' were allocated only 43.9% of the funds indicated in the Smart specialisation priority action plans. This means that attention to developing capacities of researchers to take a step from research to innovation has been decreased, keeping in mind that this was seen as most crucial aspect for successful development of the Lithuanian research system by experts.
- Measure 'Strengthening scientists and other researchers' capacities to participate in international research programmes' was decreased by 72.6%. This change decreases the likelihood of successful participation in international research programmes, such as Horizon 2020, especially keeping in mind that Lithuania was one of the lagging countries in FP7 (European Commission, 2016).

11. **Several areas that were identified in the priority roadmaps as important and belonging to the competence of the Ministry of Education and Science are not covered by the policy mix or are given little attention.**
    - Mobility of researchers – two measures (1.4 and 1.5) are related to this issue, but none cover outward mobility with requirement to return to Lithuania after a certain amount of time spent abroad.
    - Industrial doctorate or other measures aimed at attracting young researchers play only a small role in the policy mix of the Ministry of Education and Science, although it was recommended by experts.
    - Entrepreneurial education does not have a special role in the policy mix. While the concept of entrepreneurship is mentioned several times in the context of R&D commercialisation, there are no horizontal measures aiming at entrepreneurial education for students, including at the doctoral level, which would enable them to market research more easily and also help generating ideas for knowledge-intensive business.

12. **It seems that the 'stage-gate' monitoring and funding approach suggested in the priorities implementation roadmaps is abandoned**. At least there is no indication of interim targets foreseen in the priority implementation roadmaps, or the 'stage gate' approach in the PFSAs.

13. **Quota-based approach has been abandoned** by SO 1.21 and 1.2.2, and SO 1.2.1 indicate quotas at the level of six broad priority areas, although there are huge differences (up to 30-fold) in terms of budget allocated per different priorities in the action plans. This could lead to projects from priority areas marked with different maturity competing against each other. Furthermore, **there are mismatches compared to the priorities' action plans**. For example, combined share of budget indicated in the measures 'InoclusterLT' and 'InoConnectLT' has been *reduced* for 'Inclusive and creative society' (-10%) and 'Manufacturing processes, technologies and materials' (-8%) priority areas, and *increased* for 'Health technologies' (+11%) and „Energy and sustainable development' (+9%). This is not uncontroversial. For example, in the priority roadmaps it was suggested to allocate significant policy attention (and funding) for developing trans-sectoral networks related to new manufacturing processes and technologies in the first years of the 2014-2020 period. The main reason - there is substantial potential for transversal technologies in the ICT and (mechanical) engineering fields and robotics, however there is little past collaboration experience. However, it can be assumed that after separate investigation the Ministry of Economy found limited interest, i.e. limited demand, to submit proposals from related fields.

[11] The specific names of the policy instruments are different in some cases. The calculations are based on the author's assumptions as to which instruments in the priority plans correspond to which instruments in the OP for 2014-2020.

3.3. Recommendations

1. To increase more active use of the existing and new RDI infrastructure:

1.1. Ensure that all measures under SO 1.1 and/or their final results are dedicated to active use of RDI infrastructure, by local or foreign business.

1.2. Enable incentives for the *active use* of existing RDI infrastructures, for example: develop effective technology transfer centres, marketing and collaboration strategies of existing open access RIs, attract high quality researchers from abroad. These enabling incentives can be funded by specific objectives 1.2.2 and 9.3.3 of the OP.

1.3. Use financial incentives for consolidating critical mass around S3 priorities, facilitating strategic collaboration and internationalisation of the RDI system. It means that funding agencies should limit new RDI infrastructure investments strictly to the projects assessed by independent experts in a transparent selection process and meeting the **criteria:**

a. **Clear link to any of the 20 Lithuanian S3 priorities**. This can be assessed, for example, by looking for inclusion in relevant S3 background reports S3 (i.e. suggestions for priorities and priorities' roadmaps).

b. **Synergies with other RIs and research groups** in Lithuania – new infrastructure should have potential to be used to build critical mass in a particular priority field. It should be assessed if such infrastructure already exists and locations are similar, so that they could bring synergies.

c. **Relevance for actual RDI collaboration with business.** It can be assessed whether infrastructure could be used by firms by looking at background reports on S3. Furthermore, collaboration strategies and/or business intent to collaborate, and/or ex ante assessments of potential collaborations (market research) should be asked.

d. **Clear effects on RDI internationalisation** – new infrastructure should have potential to join international infrastructures or be used by foreign research performers. It should be assessed whether projects already have developed international collaboration strategies or plans.

2. To increase the extent of knowledge commercialisation and technology transfer:

2.1. To achieve economies of scale, focus on large collaborative R&D projects, involving variety of organisations including business. Merge the measures 'Joint business-science projects', 'Independent R&D projects' and 'Activities of competence centres' – these measures are funding similar activities, and added value of basic R&D is hardly justified under SO 1.2.2.

2.2. Provide financial incentives for research organisations to develop systematic and professional technology transfer activities.

a. Merge 'Technology transfer centres' with 'R&D results internationalisation and commercialisation'

b. Put substantial focus on professional technology transfer services, including support for spin-offs.

c. Create financial incentives for open access RIs to develop technology transfer strategies and action plans with sufficiently ambitious objectives and indicators, professional marketing and branding strategies, and the proactive approach – from 'business should come to us' to 'we will approach them'.

2.3. Ensure effective strengthening of RDI human resources – a key precondition for active use of RIs and knowledge transfer:

a. Create preconditions for attracting young researchers, e.g. by implementing industrial doctorate instruments, facilitating changes in the salaries of PhDs and other young researcers;

b. Implement measures for attracting RDI human resources from abroad.

c. Update researchers' career and institutional funding system. The research career criteria should be focused on high quality R&D. The researcher should be able to choose between two career directions: teaching and performing R&D.

3. To increase private sector RDI activities:

3.1. Strengthen policy instruments aimed at start-up acceleration, mentoring and venture capital funding, for example, by allocating more funding to 'TechnoInvest LT' and implementing mentorship schemes.

3.2. Consider introducing open idea competitions and challenge prizes, focused for example, on solving societal challenges linked to the Lithuanian smart specialisation, based on good practice examples like 'Solution 100' in Finland.

3.3. Introduce or strengthen schemes targeted to companies not yet engaged in RDI. This should be implemented through incentives for transformation and experimentation, such as technology platforms, foresight, innovation vouchers, active pipeline building (idea search and facilitation), and one-on-one services such as scouting, mentoring, and matchmaking. To attract currently non-performing but potential innovators, these incentives schemes could be low-barrier, industry and demand driven, and also include non-technological innovation, as recommended by OECD (2016). Consider also increasing the maximum available funding by one innovation voucher.

3.4. Address development of skilled human resources for RDI as a key emerging bottleneck to RDI development, for example by encouraging foreign researchers and high-level specialist recruitment at the Lithuanian companies, clusters and R&D institutions, postgraduate student placements in enterprises, implementing Industrial and Professional Doctorate programmes. No equipment (public or private) should be purchased without the creation and training of human resources necessary for working with it.

3.5. Seek to simplify implementation of the measures and reduce administrative load as much as possible, to reduce the substitutions effect.

4. To increase compliance to the S3 action plans and create preconditions for effective implementation of Lithuanian smart specialisation strategy:

4.1. Only RIs having clear links to the smart specialisation priorities should be funded by Thematic Objective 1 (see proposed criteria in the recommendations discussed above).

4.2. Furthermore, ERDF investments into RIs suffering from weak R&D capacities (for example, Šiauliai University) are not justified at all. The ERDF funds should not be used for 'resurrecting the dead'. Instead, it should be focused on consolidating strongest R&D capacities.

4.3. The smart specialisation monitoring system, and especially its interim indicators (both qualitative and quantitative, as suggested by the smart specialisation priorities' roadmaps) should start working immediately. An effective monitoring system and interim review results should be used as tools for:

   a. Testing the effectiveness of specific interventions, redesigning them and re-allocating budgets according to recommendations above;
   b. Testing the viability of selected 20 smart specialisation priorities (all of them have potential, but there is no guarantee this potential will be exploited). Transparent and inclusive process of the interim review should be ensured.

4.4. Synergies between different measures, OP objectives and different national and international sources should be exploited as much as possible. It means that good coordination is a prerequisite for an effective implementation of the smart specialisation priorities.

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