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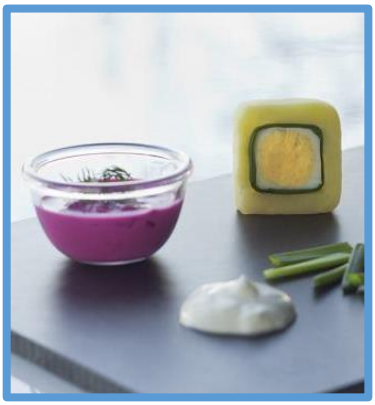

LITHUANIAN HIGH TECHNOLOGIES DEVELOPMENT FEASIBILITY STUDY

Summary

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High technologies development: key issues

- Distance between high technologies and other technologies is conditional. There is a need to abandon the statistical sector-based approach and to view high technology development as **opportunity to speed up the transformation of various economy sectors towards higher value added**. The multidisciplinary approach, generating new solutions and ideas, is highly relevant for the development of high technologies. When implementing smart specialisation in Lithuania, the key enabling technologies development and adoption strategies need to be combined, in order to:
  1. Increase the high technologies sector through the acceleration of the existing innovators and attraction of new innovators (start-ups, spin-offs and foreign investors);
  2. Modernize/restructure other economy sectors, especially the „current cornerstones" of the economy – the traditional manufacturing sectors.
- In the new 2015-2020 period the policy spotlight has to move from "hard" infrastructure development to capacity strengthening and acceleration of new ideas pipeline through the innovation support services, seeking to encourage more "potential" and "new" innovators to invest into the development of new business fields, business models and products. The "regional innovation paradox", clearly visible in Lithuania, 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[1]. One of the reasons why companies in traditional industries are less engaged in R&D activities and partnership with universities and research institutes is their lack of competences related to the acknowledgement of the value of innovation and/or capabilities related to the management of innovation process. However precisely this failure justifies the additionality of State's intervention and the need for innovative ideas facilitation and acceleration services.

Table 1. "Competence stairway" and the different needs of existing and potential innovators

Type	Technology consumers	Potential innovators	Emerging / new innovators	Mature innovators
What type of companies dominate the specific S3 priority?	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 small (below 100 employees) companies, export oriented, fast growing. The priorities where R&I potential is largely concentrated in the public science base are also in this group, with their strategies to be oriented towards economic results via spin-off creation.	Generally R&D-based large (above 100 employees), long time in the market (10 years and above), operating in the high technology sectors, export oriented, having well developed networks with the research institutions and business partners in Lithuania 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.
Needs (what should the specific policy mix focus on?)	Demand-side incentives (innovative public procurement, pre-commercial procurement, other market incentives). Capacity development (attracting highly qualified specialists, learning, technology upgrading, networking etc.)	Incentives for transformation (platforms, clusters, foresight), support for experimentation and various innovation support services encouraging moving to new products and new business models, such as "soft" idea development support, brokerage, technology services, R&D subcontracts fostering linkages with research institutions and technology transfer.	Start-up acceleration (mentors, seed and risk capital), FDI attraction, R&D infrastructure and various "hard" and "soft" innovation support services, including vouchers for technology oriented services at the science parks and similar (prototype development, validation and pilot manufacturing).	Large joint R&D projects, Horizon 2020 and other international initiatives, export support. R&D infrastructure support – only if moving to new business activities (completely new innovations). Promotion of technology diffusion and transfer from high tech to low tech industries (clusters, networking).

[1] Oughton C., Landabaso M. and Morgan K. (2002). The regional innovation paradox: Innovation policy and industrial policy. Journal of Technology Transfer 27, pp.97–110.

Type	Technology consumers	Potential innovators	Emerging / new innovators	Mature innovators
Horizontal pre-conditions and related policy interventions	Ensuring availability of high quality specialists (including upgrading higher education programmes). Clusterisation and networking promotion (open innovation platforms). Support for experimentation and foresight. Favourable framework conditions (entrepreneurship policies, flexible labour market, tax policy, R&I regulations, talent attraction policies, standardisation, favourable conditions for research careers, etc.)			

THE COMPETENCE STAIRWAY

Source: prepared by Visionary Analytics.

- In the case of many smart specialisation priorities it is justified to encourage consumption of related (high) technologies. Potential consumers of high technologies – companies with least innovation capacities – should start climbing up the "competence stairway" by strengthening the technological capabilities, upgrading production systems and managerial knowledge, attracting skilled specialists and strengthening cooperation with innovative companies in order to foster technology diffusion. The public institutions can also buy and adopt advanced technologies for modernization of the public services and functions through public innovative procurement and pre-commercial procurement.
- The already created public (including the clusters) R&D infrastructure has to be smartly exploited by connecting all infrastructures into one professionally managed virtual R&D and innovation services network. Attention should be placed not on building more (overlapping) infrastructures, but on solving "soft" issues such as exploitation of the open access centres (OACs), science and technology parks (STPs), clusters and their infrastructures, and creation of related capacities and human resources. The virtual R&D infrastructure network could allow developing innovation from idea to pilot manufacturing. At the moment, the potential of R&D infrastructure is very fragmented and scattered between the universities, institutes, clusters, and science and technology parks. Companies do not have access to this infrastructure, they do not know what infrastructure and under what conditions is available to use.
- In Lithuania, often the experimental development (especially at the 6-9 technology readiness levels, i.e. prototype testing and pilot manufacturing) is the missing link. Companies lack related financial and technological services. About 30% of surveyed manufacturing companies lack prototype testing and pilot manufacturing services. Nevertheless, 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", by creating a new Products development and manufacturing technologies centre. The centre could only be developed under a number of preconditions described in the Final Report of the Study.
- 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 business.
- The key emerging problem for high technologies development and apparently the key bottleneck of the future is the availability of skilled human resources for innovation, particularly – engineers, technologists and technology designers. Next to high economic migration and low higher education quality, the demographic trends create a scenario where the economy increasingly lacks skilled labour force, and there is a mismatch of skills supply and demand (current and future needs of companies). Hence, a key challenge is to substantially improve education and training of skilled specialists, and to design smart talent attraction policies.

Bottlenecks	Proposed solutions
Current innovation support system lacks critical mass of „soft" measures aimed at strengthening of companies' innovation	• To significantly increase the funding for innovation support services (innovation brokerage, facilitation of links between business and science, evaluation of innovation potential in specific companies, innovation ideas evaluation and facilitation, technology transfer facilitation etc.) provided by the open access centres, science and technology parks, MITA and other innovation promotion institutions.

Bottlenecks	Proposed solutions
capabilities and motivation to start new innovation activities. Lack of specialists/skills to work with newly purchased technological equipment.	• These institutions should substantially strengthen their human resources – employ and train specialists qualified to work proactively with business companies, potential foreign investors, researchers and start-ups. The proactive approach needs to be employed – from "they will come to us" to "we will come to them". • It has to be ensured that OACs have qualified specialists trained to work with sophisticated equipment, and rent those specialists to companies with the equipment use services. Specialised work clothes and occupational safety measures have to be available for rent as well. • No equipment (public or private) should be purchased without the creation and training of human resources necessary for working with it. According to the results of companies' survey, typically a one week training by foreign trainers (technologists, engineers) is needed. • Professional management of the OPCs' and clusters' infrastructure should be ensured, including professional marketing of available prototype testing/pilot manufacturing and other equipment and related services, according to the unified classification system based on business terminology. • Acceleration of innovative ideas should go hand in hand with strengthening of companies managerial capabilities (marketing, business processes, and brand development). Effective competence transfer systems based on mentors and good practice company networks should be encouraged.
New innovators need business acceleration and mentorship systems and various capital funds.	• New business acceleration systems, based on seed / start capital, mentorship and good practice systems need to be implemented similarly to the above. • One of the recommended incentives for private "business angels" investments into risky innovative start-ups is the introduction of special tax incentives. • All five currently operating risk capital funds belong under the umbrella of the JEREMIE fund. The successful initial stage should be revamped in the future, separating own funds from the EU structural funds. • With the availability of strong national venture capital funds and other investment opportunities, the country will become attractive to investors from other countries not belonging to European Economic Area. One of instruments to attract foreign investors is the "businessman visa" or "start-up visa", which allows a start-up permission to live and create business in Lithuania if he attracts additional funding.
There are too many clusters in Lithuania, organised as „closed clubs" and formed of only several companies.	• Implement incentives for merging small clusters working in similar sub-sectors and/or technology fields. The aim is that clusters become "open innovation systems" rather than "closed membership clubs". Strengthen clusters moderation and coordination support (through MITA and Enterprise Lithuania). • Strengthen the role of clusters coordinators and other „change agents" (for example, business associations) in developing foresight-based strategies for the future, encouraging companies in their sectors to move into new business models and new fields. These strategies should be strengthened/coordinated with export promotion services provided by Enterprise Lithuania. • Similarly, the Invest Lithuania should implement targeted foreign investments attraction measures, according to the smart specialisation priorities and clusters needs and their strategies.
Extensive fragmentation of various innovation support institutions (STPs, OACs, clusters) and narrow specialisation of created infrastructures. Complicated procedures applied by public infrastructures, bureaucracy, long execution periods, lack of flexibility and responsibility.	• Connect the current public R & D infrastructure into a single virtual R&D services network, ensuring synergies between thematically related public infrastructure (in the OACs, clusters, etc.), so that they allow developing innovation from idea to the market, and provide not only technological, but also related training and ideas commercialization acceleration services. • Encourage merging STPs, their "brand" development, and providing services according to the "one stop shop" principle, especially focusing on the new innovators and potential innovators. Some STPs can become more focused on start-ups acceleration, while others – on the acceleration of technological development of products from concept to deployment in the market. • Open access centres / technology centres, having the potential to provide R&D services, should become independent from universities (become separate legal entities). • Clusters' R&D infrastructure should become available to all interested parties beyond the cluster boundaries. • The created R&D and innovation technological services ecosystem has to become an integral part of at least the Baltic Sea regional innovation ecosystem.
Substantial factor limiting public sector researchers'	• Researchers contracts should be adjusted to provide time to work with the business community. The employment contract should also specify the allocation of time

Bottlenecks	Proposed solutions
collaboration with companies - the researcher's career rules (overdependence on academic publications, and little attention to the R&D results).	between teaching and R&D as well as remuneration options in case of successful applied R&D or R&D commercialisation. • The researcher should be able to choose between two career directions: teaching and performing R&D (with a small amount of lecturing hours). The researchers' career rules and performance requirements should be revised to adapt them for different types of researchers' careers. • In case of projects with business (or other R&D partners) a researcher must be able to delegate part (or all) of his/her teaching obligations to others. • A similar change should occur throughout the institutional level, i.e. institutional funding should depend (to a larger extent than is currently applied) on applied R&D results, results of cooperation with companies and R&D commercialisation (such as the amount of money earned at the national / international level, international patents, prototypes). • A researcher must be able to receive remuneration if a co-operation with a company or individual R&D leads to a commercial product / service, in accordance with the University's internal intellectual property policy. Intellectual property conditions should be specified in the annex to the employment researcher's contract. • Universities must have clear spin-off development strategies. • Incentives regarding the lecturers / researchers payroll at national level, encouraging the universities to pay competitive salaries of their researchers. Currently, universities have become public entities, and they themselves have the right to decide on their staff salaries. All cooperation projects should be carried out through the university.
The lack of qualified specialists/skills lead to low capacity not only to apply sophisticated R&D equipment, but above all - to switch to new business models and new product development.	• 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. • Establish mandatory minimal excellence requirements of the higher education programmes (especially in engineering and technology fields). • Review the study programmes in the engineering and technology fields and update them if necessary, also increasing the level of practical training bases, using sectoral and vocational training centres infrastructure. • Change in the public sector R&D institutional financing arrangements in order to encourage institutions and their lecturers and researchers to solve real business R&D problems, also involving students and PhD researchers.
Lithuania does not have any specific instruments promoting innovation demand (market for innovation).	• Implement smart measures of direct funding or fiscal support for consumers of innovative products (subsidies, tax incentives etc.), for example – measure „KETs for Industry" could be used to stimulate the market for some of the smart specialisation technologies (manufacturing technology systems). • Public procurement measures. The pre-commercial procurement could be applied at least in the case of six smart specialisation priorities. • 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.

Public R&D, business and State partnership and other systemic issues

Strengthening one individual factor does not bring direct benefits if the whole innovation system or its existing relationships and interactions are not effective. Not only the institutional structure or the incentive structure has effect on the productivity of the innovation system productivity, but also its' actors (business, education sector, consumers, the public sector), people skills and cultural features - trust, cooperation, openness level, the so-called "social capital". Both the development of high technologies and the implementation of smart specialisation requires a systematic approach and horizontal innovation policy - a policy mix, stepping outside the boundaries of one public policy. This implication leads to the need of good inter-institutional co-ordination and effective governance. Inter-institutional policy co-ordination has been discussed and analysed many times over the past few years. Despite the experts' findings and recommendations, the situation has not changed a bit since 2008.

- Lack of coordination leads to huge fragmentation of instruments, programmes, institutions and infrastructures. As a result, the various institutions play (or at least should play according to the definition of their functions) a similar role - for example, science and technology parks, technology transfer centres, open access centres, MITA, Lithuanian Innovation Centre and so on. All these institutions compete for funding that is allocated to them as "thin layer" ("*café para todos*"), making it impossible to provide professional services, to attract qualified professionals. If, without resolving the existing problems, establishment of new institutions (centres of excellence, technology centres, technology transfer centres and so on.) will continue, problems will multiply and only get worse. It is therefore necessary to reduce fragmentation, purify functions and ensure better coordination.
- There is a similar fragmentation of functions at the national agencies' level (LBSA, CPMA, MITA, LMT, ESFA). The paradox is that the creation of MITA did not decrease the fragmentation as intended, but only increased it, as instead of merging the previously existing functions, MITA was established as yet another agency with his small role and partially overlapping functions.
- Many instruments and programmes were implemented over 2007-2013, which were not coordinated, despite continued efforts to do so. Therefore the complementarity of various instruments was relatively limited. There was lack of effective and systematic programme management skills and mechanisms. One example - "valley" development, which essentially took place in an uncoordinated manner and depended on the university interests and abilities. Failure to create programme management capacities for the implementation of smart specialisation (i.e. a team/teams in one of the implementing bodies responsible for supervising the implementation of individual priorities, encouraging cooperation, monitoring, project pipeline development and so on) is likely to lead to same problems moving into a new period.
- R&D policy is too dominated by basic research and insufficient incentives are created for applied research and experimental development. The current legislation is dominated by narrow and inaccurate definition of R&D activities (often equated with "research" only), which reflects on the related policy measures and institutional as well as competitive R&D funding.

Why, even if the problems and possible solutions are correctly identified, their successful implementation always fails – a „celebrated birth" of another strategic council eventually turns into a "slow death", and the establishment of a new agency in no way diminishes the fragmentation of institutions, programmes and policy measures? One answer is – rushing the changes, half-implementing them, ignoring the effective change management principles (future impact assessment, the search for consensus, the discussion and explanation of the foreseen benefits), and the creation of necessary capacities (in particular - human resources, monitoring, evaluation). In Lithuania, there is excessive focus on legal regulation, without paying attention to the explanation of the benefits of R&D, innovation and/or collaboration to the potential stakeholders. No business or private organisation can implement change without an allocation of resources for effective change management, because the main change it needs to achieve is cultural change, without it – nothing works. When change management is ignored, another switch of the "boxes" in the institutional organogram will not have an intended effect. Among other reasons - different concepts of innovation ("science push" vs innovation systems and "demand steering") and related administrative cultures, and the side effects of the EU structural assistance administration system, which often limits the flexibility to manoeuvre and imposes bureaucratic requirements.

Bottlenecks	Proposed solutions
Fragmentation of infrastructures and institutions promoting research-business cooperation and supporting innovation.	The State should review the currently existing structures (such as clusters, science and technology parks, open-access centres), which aim to support research-business cooperation: • The number of clusters must be substantially reduced; some clusters can become part of the existing STPs; in some cases, STPs could lead the activities of clusters. • those STPs that do not function as STPs, for example, having only one building, from time to time supporting the creation of new businesses, must be reorganized (e.g., connected to the other parks, forced to change management model, and/or become independent private entities – the State would withdraw its ownership share). • Successfully operating STPs or those who can demonstrate their potential should begin initiating large cooperation projects.
Narrow and inaccurate definition of R&D, largely excluding	• In order to solve this problem, it is necessary to change the approach and revise the definition of R&D in the official legislation and to fill a gap in the innovation policy implementation measures. • Accordingly, it is necessary to adjust the statistics on R&D activities in business and researchers in business.

Bottlenecks	Proposed solutions
experimental development.	
Fragmentation of programmes, poor coordination at the implementation and strategic levels, and weak programme management capacities.	• The combined use of policy instruments, especially when it comes to public research sector and business cooperation. In order to achieve economies of scale by using funding of various state institutions, it is advisable to focus on larger rather than small-scale projects. These larger projects usually involve several stakeholders, do not rely on a single source of funding, have large budgets, longer period of implementation and a few groups of beneficiaries.
	• At the strategic level, to strengthen the Strategic R&D and Innovation Council's mandate for the coordination of R&D and innovation strategy. SMTEPI Council's Secretariat's analytical resources should be strengthened and its functions should be better coordinated.
	• Clearly define MITA as a coordinating authority of the implementation of smart specialisation. If these functions are assigned to (or will be assigned) to another institution, clearly specify the chosen institution. It is important to create strong programme management skills - teams responsible for the implementation of the smart specialisation priorities and supervision of project pipeline initiation.
	• Implementation of the priorities will unavoidably face many risks, therefore there is a need for timely and effective data collection, monitoring and analysis of information on the success of the implementation progress, for developing strategic intelligence about the extent to which decisions / priorities were justified, and what changes/review are necessary.
	• Better co-operation between public authorities can be promoted through a staff exchange / internship program - exchange of personnel between the ministries / agencies for 3-6 months.
	• Innovation should be embedded as a horizontal objective of all ministries, by assigning a responsible official at each of the sectoral ministries, and including these officials in the innovation policy coordination processes. It should help educating "agents of change" within the sectoral policies.
Fragmentation of policy implementing agencies, overlapping functions, process-based „administration of funds" vs building content-related competences.	• Lithuania's transition to national funds in the post-2020 period will increase pressure on innovation policy effectiveness. The goal of "smooth administration of EU funds" will become irrelevant. Looking at these mid-term challenges, it is inevitable to reduce institutional fragmentation by consolidating existing institutions and / or purifying their functions. Previous studies (e.g. the "valleys" monitoring project) recommended strengthening of MITA and LMT, and ensuring that LMT becomes responsible for financing instruments relating only to basic research, and MITA becomes responsible for all the applied R&D or strategic nature innovation policy programs (integrating the respective functions of LBSA and CPMA). • Discussion on the change of institutional framework, based on the relevant alternatives and their potential impact analysis, should be launched involving stakeholders and allocating resources for change management.