

Estonian Research and Development and Innovation Strategy 2014-2020 “Knowledge-based Estonia”

Summary

This is the third Estonian Research and Development and Innovation (RDI) strategy. It takes into account the experience, lessons and expert recommendations from the previous period, the obligations arising from the Constitution and other legislation, as well as future trends. Although Estonia has been successful in the implementation of its RDI policy, there are still many opportunities for further development. The achieved strengths must be preserved and the weaknesses reduced.

The overall aim of the development of RDI is to create favourable conditions for an increase in productivity and in the standard of living, for good-quality education and culture, and for the longevity and development of Estonia. This strategy establishes four main objectives for Estonia.

- 1) **Research in Estonia is of a high level and diverse.** It is internationally competitive and visible, and covers the main fields of higher education and culture. The network of research institutions operates efficiently. The infrastructure is modern. A new generation of researchers and innovators is ensured. Estonia is an attractive place for research and development, and a researcher career is popular.
- 2) **Research and development (RD) functions in the interests of the Estonian society and economy.** It proceeds from the needs of society and the economy, and prioritises research applications. Research institutions are motivated to undertake applied research and for productive cooperation with enterprises and government authorities. The state is smart in commissioning applied research and development. The organisation of research carried out for socio-economic objectives is efficient.
- 3) **RD makes the structure of the economy more knowledge-intensive.** RDI investments selected and managed by the smart specialisation method encourage the development of growth fields at a faster than expected pace. The share of knowledge-intensive entrepreneurship in the economy and the added value of exports will increase significantly. The selected fields of growth are:
 1. Information and communication technology (ICT), horizontally through other sectors¹
 2. Health technologies and services²
 3. More effective use of resources³
- 4) **Estonia is active and visible in international RDI cooperation.** Cross-border cooperation helps solve the tasks that Estonia, and the world as a whole, is facing. Estonia participates as a partner in the initiatives of the European Research Area, (incl. in the joint programming of research), European innovation partnerships, initiatives by the Baltic and Nordic common area, international research infrastructures. Enterprises have access to the world's newest RDI results, and cooperation opportunities and infrastructures are open to them.

¹ E.g. use of ICT in industry (incl. automatization and robotics), cybersecurity, software development

² E.g. biotechnology, e-health (use of IT for the development of medical services and products)

³ E.g. materials science and industry, innovative construction, i.e. “smart house”, health promoting food, chemical industry (more effective use of oil shale)

Whereas the former strategies have focussed mainly on the development of our RDI capacity, the objective of the present strategy is to use the created potential for the development and economic growth of Estonia. Priorities are set on the basis of the new, smart specialisation method. In order for the cross-field coordination to work more smoothly, a number of management and monitoring issues have been detailed.

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Introduction

The quantity and complexity of problems facing a society are increasing across the world. Amongst a country's development objectives there is generally a priority to increase the competitiveness of the economy and to have a successful functioning of society, a high standard of living and an increase in the welfare of its population. The more successful countries invest heavily in education, RD and innovation, making efforts to increase the impact of research, to retain existing - and gain new - top specialists, and to ensure economic growth and the longevity of statehood and culture. In Estonia we must also again review our current activities and seek new ways to progress further. The more we achieve in our development, the more demanding we must also become towards our research policy.

In the last decade Estonian society and the economy have developed rapidly as a whole; as a result of the economic crisis, the structure of the economy is also changing. Ensuring further development requires increasing the attention paid to achieving a better position in the international value chain and to increasing the welfare of people living in Estonia.

This strategy determines the directions for the development of research and development and innovation, on the basis of which one of the most important and central fields of activity in Estonian society can be managed in a more interconnected manner, where public financial resources can be better applied, and the competitiveness of the state and the welfare of the population can be increased.

This is the third Estonian RDI strategy. It takes into account the previous period's experiences, the lessons learned and the recommendations made by top experts, the obligations arising from the Constitution and other legislation, as well as future trends.

This strategy has been prepared with the involvement of the Research and Development Council (RDC), the RDI strategy committee, the research policy committee, the innovation policy committee and representatives from the Research and Innovation Policy Monitoring Programme (TIPS), research institutions, entrepreneurs and state authorities.

1. BACKGROUND

1.1. Development trends affecting research and development and innovation

Research and development depends on developments in the world, as well as in Estonia.

- The economic crisis has increased the importance of RDI policy particularly since it has enabled and encouraged structural changes in the economy.
- Political choices in the world are affected by global trends – demographic development, public health and ageing, the environment and climate, and the need for raw materials and energy. Solutions for global problems are sought through the development of science and technology and they are applied ever increasingly in cooperation between the public and private sectors.
- There is more competition amongst countries regarding the location chosen by the best entrepreneurs and specialists. A well-functioning RDI system and an intellectual environment will bring us quality investment and people, and also retain them.

- Methods for carrying out research change. The increased cross-field nature of research presumes new forms of cooperation⁴, the extremely rapid increase in data volumes requires the development of data recording infrastructures and information processing technology, e-infrastructures and dispersed infrastructures enable remote and joint management of test facilities, research publications and research data that are available without charge increase the impact of research results.
- Globalisation of research and production (division of labour) affects the location of new research centres. The share of developing countries, particularly in Asia, in research and among researchers is growing, thereby increasing the capacity of high-technology production in these countries. International cooperation in research has become the rule.
- The “Europe 2020” strategy for employment and growth directs and supports the development of Member States’ research and finances it both from cohesion policy and central funds. The activities of the Flagship Initiative “Innovation Union”⁵, the European Research Area (ERA) and the higher education area aim to coordinate the policy of different Member States and achieve synergy. There is extensive cooperation between Member States of the European Union (EU) in the field of research infrastructures⁶.

1.2. Estonian societal requirements, the general tasks of research and development and innovation, and links to other strategies

Research and development is important in the functioning of education, culture, the economy and society. The tasks of RDI arise from the Constitution, other legislation and the general strategies of Estonia and the European Union. The RDI strategy is closely linked to the Estonian Lifelong Learning Strategy 2014-2020, Estonian Entrepreneurship Growth Strategy 2014-2020 and other related strategies. The general tasks of RDI are:

- ensure a scientific basis for education⁷ and the longevity of culture⁸;
- find new sources of growth for entrepreneurship in the conditions of unemployment and the rising cost of labour, to make the economy more knowledge-intensive⁹;
- improve the welfare of the population, increase work capacity, adjust to demographic processes, achieve balanced migration; develop the living environment and opportunities for development in a regionally balanced manner;
- find solutions to problems caused by increasing social demand and a global scarcity of resources, find development opportunities for society and ensure energy and food security.

The Estonian competitiveness strategy “Estonia 2020” prepared in accordance with the “Europe 2020” strategy establishes the following objectives:

- increase productivity per employed person to 80% of the EU average (2020);
- raise the level of investment in research and development to 3% of GDP (2020);
- increase the share of Estonian exports in world trade to 0.11% (2020).

⁴ OECD Science, Technology and Industry Outlook 2012, p. 66

⁵ Europe 2020 Flagship Initiative “Innovation Union”, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0546:FIN:ET:PDF>.

⁶ See the action plan of the European Strategy Forum on Research Infrastructures (ESFRI)

http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri-roadmap, and the European Research Infrastructure Consortium (ERIC)

http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=eric.

⁷ Clause 2 9) of the Universities Act and § 3 of the Basic Schools and Upper Secondary Schools Act

⁸ According to the preamble of the Constitution

⁹ R. Kattel, E. Karo, P. Tõnurist, L. Looga, U. Varblane, T. Roolaht, “Assessment of the implementation of the research and development and innovation strategy”, <http://www.tips.ut.ee/index.php?module=32&op=1&id=3532>, report of the TIPS programme, 2012

1.3. Overview of research and development and innovation in Estonia

Overviews of research and development have been published regularly in strategy reports¹⁰.

- After the restoration of independence, Estonia has been successful in improving the quality and increasing the volume of academic research. Since accession to the European Union, a significant proportion of EU Structural Fund aid has been directed to the development of RD infrastructure, human capital and entrepreneurship. This has helped create modern conditions and an attractive environment for research, added to the number of researchers and broadened opportunities for international cooperation.
- A functioning and developing RDI system based on quality competition, and a support structure for the entrepreneurship sector, have been created. Structural reforms have been implemented and a legislative framework has been created.
- The volume of RD has increased faster than the GDP. In Estonia this improvement in RD activity has been achieved due to a rapid increase in private sector RD as well as with the support of the public sector.
- The structure of Estonian RDI in the economy¹¹ has been formed over time due to the interaction of a number of factors. Although productivity has increased rapidly, there are still too few enterprises associated with RD and who cooperate with universities. Increasing added value in all economic sectors is still a real challenge (in certain sectors, productivity in Finland is more than double that of Estonia). The potential impact of research policy measures on the economy is greatest in those fields where there is considerable mutual capacity.
- Thanks to the efficiency of research and an increase in its volume, researchers in Estonia have reached the forefront in several fields on a global level. Whereas in the European Union the rate of publishing increases on average by 5% a year, the annual average increase in the number of publications for Estonia has been 11% (during the period of the strategy) . At the same time the impact of the published results has also increased.
- Despite an increase in the number of PhDs awarded annually, and an increase in the proportion of researchers, the completion rate and impact of doctoral studies has not been sufficient to make changes to the structure of the economy or to fulfil the needs of society.
- Launching field-specific RD programmes has been slow. The role of ministries in determining the needs of society is generally minor and the coordination activity in and between ministries for commissioning the RD required by the state has been insufficient.
- Competence centres have supported cooperation between enterprises and research institutions, and the cluster programme has supported cooperation between enterprises, but the latter has provided no support to RD activities.
- Since there are numerous sources of financing and legal acts, RD measures are fragmented. This has resulted in an increase in the administrative burden and difficulties in the coordination of measures.
- Although the internationalisation of research has been actively initiated in recent years, not all of its possibilities have yet been sufficiently well-utilised.

¹⁰ Reports on the research and development and innovation strategy, Ministry of Education and Research, <http://www.hm.ee/index.php7Q3242>.

¹¹ EE *et al.* 2012. Quantitative analysis of the Estonian economy, by sector

1.4. Main recommendations

The studies carried out for the assessment of the Estonian RDI system have brought to the fore a considerable number of problems and recommendations, which need to be the focus for the new strategy.¹²

- Estonia must continue its current efforts in moving towards being a knowledge-based society, paying more attention to the direct tasks facing the economy and society. The RDI policy must be regarded as a means to achieve economic and social objectives. To change the structure of the economy, more attention must be paid to increasing the added value in traditional sectors.
- There needs to be awareness that innovatively combining fields of technology already existing in the world is a strategically promising opportunity to develop new functionalities (e.g. mobile parking). Due to its small size and the easy and fast achievement of cooperation between economic sectors and authorities, Estonia has a significant advantage in this area over large countries.
- A clearer focus must be set for national RDI programmes by reducing their number and making their implementation more efficient. In the future it would pay to concentrate on a limited number of fields of growth, according to the smart specialisation concept. Preference must be given to the development of these fields, in cooperation with ministries, with the help of both RDI and entrepreneurship policy measures.¹³
- Cooperation between research and development institutions, and between enterprises, must be improved significantly. Professional associations and entrepreneurs must be involved more as partners in the development of policy and programmes.
- The system for the legal protection of intellectual property must be updated so that it could provide even better support to research and development and innovation – taking into account the smallness of the country. Special attention must be paid to the implementation of Estonian intellectual property policy at EU and international level.
- One of the most important barriers to the development of the Estonian economy and society is the limited human capital. Opportunities must be found for a better engagement of our current population, and improving their competences as well as for bringing foreign specialists to Estonia. The problems related to the new generation start at the lower educational levels. Estonia needs a migration policy that supports the study and employment of specialists that are required for the state and the economy.
- According to the Constitution, RD in the field of the Estonian language and culture must be continued and developed. Developing humanities, including encouraging their cross-field nature, is needed for the communication and implementation of knowledge¹⁴.

¹² The European Research Area Committee (ERAC), "Peer-Review of the Estonian Research and Innovation System", 2012, http://www.mkm.ee/public/ERAC_EE_Peer-Review_Report_2012.pdf; discussion paper of the Research and Development Council "Main trends of the research and development and innovation policy in the following years", 2012, <http://valitsus.ee/UserFiles/valitsus/et/riigikantselei/strateegia/teadus-ia-innovatsioonipoliitika/teadus-ia-arendusnoukoqu/TAN%20arutelupaber%20120612.pdf>; T. Käivet, E. Karo, R Kattel (ed.), "New opportunities for enterprises in Estonia – business models, open innovation and choices of the state", 2010,

<http://www.arengufond.ee/upload/Editor/ettevotlus/Eesti%20ettev%C3%B5tete%20uued%20v%C3%B5imalused%20%E2%80%93%20>

[0%C3%A4rimudelid.%20avatud%20innovatsiooni%20ia%20riiqi%20valikud%202010.pdf](http://www.arengufond.ee/upload/Editor/ettevotlus/Eesti%20ettev%C3%B5tete%20uued%20v%C3%B5imalused%20%E2%80%93%200%C3%A4rimudelid.%20avatud%20innovatsiooni%20ia%20riiqi%20valikud%202010.pdf); INNO-Policy TrendChart - Innovation Policy Progress Report for Estonia 2009.

¹³ R. Kattel, E. Karo, P. Tõnurist, L. Looga, U. Varblane, T. Roolah, "Assessment of the implementation of the research and development and innovation strategy", <http://www.tips.ut.ee/index.php?module=32&op=1&id=3532>, report of the TIPS programme, 2012

¹⁴ Discussion paper of the Research and Development Council "Main trends of the research and development and innovation policy in the following years", 2012, <http://valitsus.ee/UserFiles/valitsus/et/riigikantselei/strateegia/teadus-ia-innovatsioonipoliitika/teadus-ia-arendusnoukoqu/TAN%20arutelupaber%20120612.pdf>.

- In order to ensure knowledge-based higher education and the efficiency of both research and the higher educational system, the priorities and financing of research and higher education must be linked more closely.
- International research cooperation between the state, research and development institutions as well as enterprises must be improved. In order for Estonia to share in the results of joint initiatives and in order for us to have a better outlook for implementing these for the benefit of our economy and society, it is important to achieve a closer connection with the initiatives of the European Research Area (incl. joint programming of research, European innovation partnership, initiatives of the common area of the Baltic and Nordic countries) and to participate in pan-European RD infrastructures. To enhance domestic research and development, it is also important to use the potential of the European Union research and innovation framework programme "Horizon 2020".
- More attention must be paid to the implementation of policy and the reinforcement of central coordination. Ministries must also be involved more in the development and implementation of RDI policy. The role of the Research and Development Council needs to be made more specific.
- In order to develop research organisation and infrastructure, the structure of the public research and development institutions must be reviewed. It is also necessary to implement the initiated measures for the modernisation of infrastructure, to ensure the sustainability of the infrastructure and achieve its efficient joint use, including opening services to enterprises.
- The scope and selection of the RDI instruments must be extended. In the development of the RDI measures system, more attention must be paid to enterprises with potential, but which do not yet contribute to development activity. Innovation policy resources must also be increased in the fields of service innovation, knowledge and technology transfer, organisational and process innovation. Enterprises' access to financing for innovation must be improved, wherever possible using market-based investment in order to preserve an encouragement-based motivation system.
- The target to be set should be a reduction in the fragmentation in financing research and innovation, which includes examining the possibilities and need for a consolidation of measures (particularly taking into account the great dependence on the resources of EU Structural Funds and the need for a future exit strategy).
- Effective strategy management requires the reorganisation of the statistics and monitoring system for financing RD.

2. VISION

By 2020:

The fast and flexible implementation of research results and knowledge for improving social and economic welfare in Estonia is accepted as being a natural and everyday activity;

Estonian researchers have achieved outstanding results globally, Estonian research is internationally competitive and a natural part of the Nordic and European Research Area;

Estonia has good conditions for the creation of entrepreneurship of high added value. Estonia is globally known and visible as the developer and implementer of new technological solutions;

Estonian society is innovative, understands the need for research and development, and values highly qualified research staff.

3. OBJECTIVES IN PROMOTING RESEARCH AND DEVELOPMENT AND INNOVATION

. **The overall aim of the development of RDI is to create favourable conditions for an increase in productivity and in the standard of living, for good-quality education and culture, and for the longevity and development of Estonia.**

It is important to achieve a balanced, harmonious and sustainable RDI system, where resources must be utilised for the benefit of society and for the development of new products and services. The main task of the new strategy is to increase the impact of the research system in Estonia in solving the challenges facing society as well as improving the competitiveness of the economy.

Target level of indicators for 2020:

- investment in research and development: 3% of GDP, incl. private sector RD expenditures: 2% of GDP (2011: 2.41% and 1.52% of GDP, respectively);
- 10th position (minimum) in the EU Innovation Union Scoreboard (2011: 14th position);
- enterprise productivity per person employed: 80% of the EU average (2011: 68%).

Objectives

1. Research in Estonia is of a high level and diverse. It is internationally competitive and visible, and covers the main fields of higher education and culture. The network of research institutions operates efficiently. The infrastructure is modern. A new generation of researchers and innovators is ensured. Estonia is an attractive place for research and development, and a researcher career is popular.

Target level of indicators for 2020:

- 11% of all top-level research publications in Estonia are among the top 10% most cited research publications worldwide (2008: 7.5%);
- number of new doctorate graduates in an academic year: 300 (2012: 190);
- number of top-level articles per million population: 1600 (2012: 1191).

2. Research and development (RD) functions in the interests of the Estonian society and economy. It proceeds from the needs of society and the economy, and prioritises research applications. Research institutions are motivated to undertake applied research and for productive cooperation with enterprises and government authorities. The state is smart in commissioning applied research and development. The organisation of research carried out for socio-economic objectives is efficient

Target level of indicators for 2020:

- proportion of expenditure on socio-economic applications (except academic studies) from RD appropriations in the state budget: 40% (2011: 30%);
- private sector RD funding of public sector RD forms 7% of total public sector RD expenditures (2011: 3.1%).

3. **. RD makes the structure of the economy more knowledge-intensive.** RDI investments selected and managed by the smart specialisation method encourage the development of growth fields at a faster than expected pace. The share of knowledge-intensive entrepreneurship in the economy and the added value of exports will increase significantly.

Target level of indicators for 2020:

- share of employment in high and medium-high-technology sectors in total employment: 9% (2010: 6%);
- share of high-technology products and services in exports: 15% (2010: 10.4%).

4. **. Estonia is active and visible in international RDI cooperation.** Cross-border cooperation helps solve the tasks facing Estonia and the world as a whole. Estonia participates as a partner in the initiatives of the European Research Area, (incl. in the joint programming of research), European innovation partnerships, and initiatives by the Baltic and Nordic common area, international research infrastructures. Enterprises have access to the world's newest RDI results, and cooperation opportunities and infrastructures are open to them.

Target level of indicators for 2020:

- The success of Estonia is reflected in the volume of contracts, per capita, won through the European Union research and innovation framework programme "Horizon 2020": 100% of the EU average (2011: 87% of the EU average);
- share of internationally coordinated research in the state-financed RD's 3% (2010: 1.31%).

4. MEASURES FOR ACHIEVING THE OBJECTIVES

The following are the major measures and activities for the achievement of the objectives as presented on the basis of the recommendations and results of the SWOT analysis (Appendix 1). The activities not presented are those less relevant to the strategy or those where no major changes are planned.

Although each measure has its objectives and target levels, they also support the achievement of the objectives of other measures. This means that all the measures are related to smart specialisation and contribute to the achievement of a greater social and economic benefit of RD. For example, Measure 1 – ensuring the high level and diversity of research – helps achieve a greater social and economic benefit (Measure 2), smart specialisation (Measure 3) as well as internationalisation (Measure 4). The latter, in turn, contributes to the development of excellent research and smart specialisation.

Programmes launched for the purpose of smart specialisation – changing the structure of the economy – may include activities that are not conventional in the field of RDI. On the other hand, supporting the fields of growth of smart specialisation has been planned in the implementation of policies by several areas of government.

Measure 1. Ensuring the high level and diversity of research

In order to preserve a high-level educational and cultural environment and shape a more desirable position for Estonia in the competition for location, it is necessary to increase the competitiveness of RD and ensure diversity in covering the main fields. To this end, the organisation of research must preserve the quality-based financing of research, develop an attractive environment for research, and support autonomy and specialisation of institutions of higher education and research institutions. Investments in the development of human capital must be preferred, efforts must be made to ensure a new academic generation and to increase the number of researchers and engineers in the private sector involving talented young people both from Estonia and abroad. The bureaucracy involved in the measures for the EU Structural Funds must be simplified and reduced, and the number of measures themselves must be reduced.

- 1.1. Support the development of areas of responsibility of institutions of higher education and research and development institutions, also their structural changes, focussing on strategic fundamental activities

and the reorganisation of the network of institutions; increase the responsibility of research institutions for the effectiveness of their activities.

- 1.2. Ensure an increase in the level of the main financing instruments (baseline financing, institutional and personal research grants, grants for the maintenance and sustainable development of infrastructure, etc) of research and development in line with the temporary nature of investments from the Structural Funds, in order to ensure the continuation of the RDI system and the realisation of the created capacity. The combined effect of different financing instruments and a balanced development of the RDI system will be ensured.
- 1.3. Support research centres of excellence in performing frontier research.
- 1.4. Support research grant applicants - who achieve very good results in international top-level competitions (European Research Council (ERC), European Molecular Biology Organization (EMBO)) but who do not receive a positive financing decision - in carrying out their planned research in Estonia.
- 1.5. Reinforce, with the help of European Union Structural Funds and activities financed from the state budget, the capacity of Estonian research institutions to participate in forms of cooperation based on quality competition, incl. in the programme "Horizon 2020".
- 1.6. Develop a career model which supports cooperation with enterprises and individual development possibilities, encourages occupational mobility, incl. in the entrepreneurship sector, and motivates young people to choose the profession of a researcher or an engineer. Support the openness of competitions for academic positions to foreign researchers. Monitor that equal opportunities, incl. gender balance, be ensured when filling positions, allocating grants and forming decision-making bodies.
- 1.7. Ensure a new generation of researchers and engineers, incl. paying increased attention to the systematic development of doctoral studies, and ensure the competitive financing of doctoral studies (incl. PhD grants), continue supporting doctoral studies, the position of junior research fellow and post-doctoral studies.
- 1.8. Continue shaping, in inter-ministerial cooperation, a smart and flexible migration policy, and policy supporting the adaptation of new immigrants, which would increase the attractiveness of Estonia as a target country for research and study.
- 1.9. Increase researcher mobility, incl. from enterprises, and ensure integrated financing of the research groups led by top researchers who have come to or are already in Estonia. Reinforce the impact of the researcher-professor institution in the RD.
- 1.10. Promote research and research education in society. Ensure the availability of adequate career information for young people about the career opportunities for researchers and engineers, both in the public and business sectors, incl. by increasingly involving enterprises, as potential employers, in the promotion activities. Support the content development of youth hobby groups in the field of natural, exact and engineering sciences as well as in technology. Encourage cooperation between research institutions, enterprises and schools in the promotion of science and the development of study materials in the field of natural, exact and engineering sciences, and in technology.
- 1.11. Support consistently the preservation, expansion, digitisation and availability of data archives and research collections that are important for research and culture.

- 1.12. Ensure systematic development of infrastructure, incl. digital infrastructure. Plan investments in research infrastructure of national importance on the basis of a regularly updated action plan, taking into account the quality conditions established in links with international infrastructures.

Measure 2. Increasing the social and economic benefit of RD

Research in Estonia has reached the forefront in several fields on a global level, but it has been modest in achieving social and economic objectives. Cooperation between research institutions and enterprises must improve significantly and also be open to new participants. The organisation of applied and socio-economic research must be carried out systematically. The competence of the state as the body commissioning research and development must be increased.

- 2.1. Ensure support for studies of a high scientific level in the field of Estonian language, history and culture, and the development of language-technology solutions and encourage their extensive application.
- 2.2. Encourage the mobility of researchers between the academic, public and private sectors. As regards a researcher's career, place value on the time worked in other sectors and the results achieved there, as well as cooperation with enterprises. Continue supporting doctoral studies that are provided in cooperation with universities and enterprises.
- 2.3. Support the joint use of research infrastructure among enterprises and research institutions, and develop rules for the joint use of infrastructures.
- 2.4. Review the motivation system related to commercialisation in universities, linking it with the main objectives and the financing of universities. Increase the professionalism and impact of commercialisation and reinforce links with other participants in the innovation system – investors, incubators, science parks, etc. Continue the development of competence in the field of knowledge transfer, incl. the training and bringing in of experts, the development of the organisation and quality of knowledge transfer and the extension of the international contact network. Promote increasing awareness of intellectual property among researchers, students as well as the non-academic staff of universities.
- 2.5. Support the development of entrepreneurship studies and new forms of acquisition of entrepreneurship experience by involving more enterprises than before - as lecturers, practice providers, etc.
- 2.6. Improve the availability of capital for start-up enterprises coming from universities.
- 2.7. Support enterprises in the development of products and services of high added value in cooperation with universities and RD institutions, incl. continuing, also in traditional economic sectors, to increase added value through RD and improve the strategic development capacity of enterprises.
- 2.8. Reinforce cooperation between the Estonian Research Council and Enterprise Estonia in order to achieve better conformity between research institutions and enterprises and to achieve a system of RD grants, incl. merged research grants, which are compatible and complementary.
- 2.9. Encourage raising more money from the private sector for financing universities. Encourage bringing in foreign investments of higher added value based on RDI capacity (development centres, extending current investments to development activities, start-ups) by providing foreign investors with RD vouchers and using the potential of centres of competence.
- 2.10. Continue the development of central research information systems and services with the objective of making these convenient for foreign users (incl. state authorities and enterprises) and to allow fast access to research topics, performers and results.

- 2.11. Encourage open access to public-financed research results and research data. Support extensions to databases in research institutions and research libraries, and ensure access to the most important research databases.
- 2.12. Take measures to increase the RD responsibility and capacity of ministries. Create forms of inter-ministerial cooperation for additional financing and the better organisation of research and development in areas of government, proceeding from the principle that the main responsibility for the RD financed for socio-economic purposes is with the ministry in charge of the field.
- 2.13. Create conditions for society to place value on an academic degree, incl. preferring persons with an academic degree when filling leading positions in the public sector.

Measure 3. Smart specialisation is the basis for RDI in changing the structure of economy

In conditions where the state interferes with the economy as little as possible, one of the opportunities to affect the structure of the economy is the focussed support of carefully selected RDI fields and activities. The OECD is developing the smart specialisation method¹⁵ for the selection of suitable fields of growth and the management of the selection process. In the achievement of its strategic objectives, the European Union has established smart specialisation as a condition for use of the resources of the Structural Funds¹⁶.

On the basis of an analysis¹⁷ organised by the Development Fund and made in cooperation between enterprises and research institutions, the fields of growth are the following:

1. Information and communication technology (ICT) horizontally through other sectors¹⁸
2. Health technologies and services¹⁹
3. More effective use of resources²⁰

The objective is to significantly improve the share of employment and added value of entrepreneurship in the economy and exports. Monitoring and activities will be initiated in each selected field of growth on the basis of an analysis of the bottlenecks.

- 3.1. Create national programmes to support smart specialisation, which include the required measures for reinforcing the fields of growth²¹, and determine the responsible organisation.
- 3.2. Support a new generation and increased number of researchers and engineers in the fields of growth; ensure an increase in the research capacity of research institutions in the public sector and an infrastructure for the development of business cooperation.
- 3.3. Develop activities of cooperation networks between enterprises and RD institutions in the fields of growth (incl. centres of competence and clusters).

¹⁵ OECD Smart specialisation project <http://www.oecd.org/sti/inno/smartspecialisation.htm>.

¹⁶ Council Regulation (EC) No 1083/2006 of 11 July 2006 laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund and repealing Regulation (EC) No 1260/1999, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:210:0025:0078:ET:PDF>.

¹⁷ Estonian Development Fund "Smart specialisation – Qualitative analysis", 20.02.2013, <http://www.arenufond.ee/upload/Editor/Publikatsioonid/Nutikas%20spetsialiseerumine%202013.pdf>.

¹⁸ E.g. use of ICT in industry (incl. automation and robotics), cybersecurity, software development

¹⁹ E.g. biotechnology, e-health (use of IT for the development of medical services and products)

²⁰ E.g. materials science and industry, innovative construction, i.e. "smart house", health-supporting food, chemical industry (more effective use of oil shale)

²¹ One of the documents used is "Smart specialisation – analysis of bottlenecks and new opportunities" (interim report 19.06.2013) drawn up by the Estonian Development Fund, http://www.arenufond.ee/wp-content/uploads/2013/06/AF_kitsaskohad_final2.pdf.

- 3.4. Keep in mind and highlight fields of growth in the case of RDI and other policy measures implemented in the public sector, incl. in applying student speciality grants, developing the objectives for research institutions and planning and implementing the activities of science parks, etc.
- 3.5. Increase the capacity of enterprises through commencing to use information and communication technology and other technological developments. Support the strategic use of design in enterprises in order to increase the added value of products and services, and achieve international visibility.
- 3.6. Increase the role of the public sector as the leader of innovation in enterprises under the fields of growth of smart specialisation, i.e. in commissioning and initiating RD and innovation. The innovations include innovative procurements, development activities of enterprises under the leadership of the public sector, design of public services, public and private sector partnership, demonstration projects as well as the infrastructure and information technology solutions required.

Measure 4. Increasing the participation and visibility of Estonia in international RDI cooperation

Solving the major problems facing the state and mankind is so resource intensive that even big countries cannot cope with it alone - these therefore should be addressed in cooperation. Estonia must choose: what is it that we can do, and what is it we cannot – at least not at a sufficiently high level.

In international cooperation Estonia needs to make its contribution in solving the problems facing Estonia as well as the world, and in achieving the objectives of the European Union. Secondly, Estonian participation in international research programmes enables to bring in additional resources, new knowledge, commissions and opportunities for the development of the high-technology economy of our country. The open research system of Estonia supports and encourages contacts between our researchers and their colleagues abroad since increasing international cooperation in research is a natural part of the development of research. Cooperation in research favours the other objectives of Estonia, incl. enhancing recognition and our reputation in the world.

- 4.1. Ensure in inter-ministerial cooperation the participation of Estonia in initiatives of the European Research Area (incl. in the joint programming of research), European innovation partnerships, initiatives of the common area of the Baltic and Nordic countries), coordinate between ministries the participation of Estonia in research programmes of the Member States implemented for socio-economic objectives.
- 4.2. Ensure access of Estonian research institutions and enterprises to the international research infrastructure; participate through the roadmap of the European Strategy Forum on Research Infrastructures (ESFRI) in the establishment of those research infrastructures that are most important for Estonia.
- 4.3. Ensure the openness of Estonian research and development programmes for international cooperation on mutually beneficial bases.
- 4.4. Develop cooperation opportunities with third country researchers and research institutions.
- 4.5. Enhance the international introduction of achievements by Estonian research and researchers as well as the innovation activities of enterprises.
- 4.6. Create opportunities for Estonian enterprises and research and development institutions for receiving high-technology orders through the participation in international research infrastructures (incl. European Organization for Nuclear Research, European Space Agency, research centre European Spallation Source (ESS), International Thermonuclear Experimental Reactor (ITER), MAX-LAB, etc).

5. STRATEGY MANAGEMENT AND FINANCING

5.1. Management and coordination

- The authority responsible for the implementation of the strategy is MoER together with the Ministry of Economic Affairs and Communications and other ministries.
- The person responsible for the RD of each ministry represents his/her ministry in the coordination of activities, participates in the preparation of the implementation plan of the strategy and exchanges RD information in the state budget planning process and in the preparation of overviews and reports.
- The RDC discusses the implementation plan of the strategy each year prior to its submission to the Government of the Republic for approval, provides an assessment of the implementation of the strategy in the previous year and the recommendations for the future. The RDC discusses on an annual basis:
 - activities for supporting fields of growth,
 - RD related to the achievement of socio-economic objectives in the ministries.
- The Ministry of Education and Research coordinates information exchange on RD between ministries.
- The Government Office prepares the RDC meetings and represents the RDC in between meetings, incl. in national programme councils and in the organisation of international cooperation.
- In order to support fields of growth, national RD programmes, which are subject to annual analysis and monitoring, are initiated under the RDI strategy. The management of national RD programmes is organised by the ministry responsible for the relevant field.

5.2. Links with other strategies, and the strategic framework of smart specialisation

The implementation of the RDI strategy and the entrepreneurship growth strategy, monitoring the fulfilment of objectives thereof and, where necessary, making proposals for amendments (incl. proposals for amending financing allocations) takes place according to the procedure established in law (incl. Research and Development Organisation Act, Structural Assistance Act) and secondary legislation, according to the existing coordination mechanisms and the future steering committee of smart specialisation. This information is one of the inputs in the implementation, management and monitoring of the implementation plan of the Cohesion Policy.

- A more detailed description and division of tasks of the management, monitoring and the coordination system of the strategies is set out in the implementation plans of the RDI strategy and the entrepreneurship growth strategy.

The achievement of objectives of smart specialisation is, in addition to the RDI strategy and the entrepreneurship growth strategy, related to the implementation of other field-specific development plans, incl. the "Information Society Development Plan 2014-2020", "Lifelong Learning Strategy 2014-2020", "Rural Development Plan 2014-2020" and other development plans concerning fields of growth.

- For the purpose of cross-field management of smart specialisation, a steering committee will be formed, which will consist of representatives of the Ministry of Education and Research, the Ministry of Economic Affairs and Communications, the Government Office, the Ministry of Finance and, if necessary, from other ministries and enterprises. The role of the Development Fund is the organisation of the work of the steering committee and the provision of input to decisions; the Development Fund, however, has no decision-making powers.

- The task of the steering committee is to monitor the fulfilment of the established objectives and that there is progress towards these and, if necessary, to make proposals to ministries, the IPC and the RPC for amendments to the measures and activities of the strategies or to initiate amendment of the strategies.
- The objectives and ways of measuring smart specialisation will be planned on the basis of measures, according to the objectives established in the strategies.
- The entity responsible for the current monitoring and analysis of fields of growth, unless otherwise agreed, is the Estonian Development Fund, which regularly involves enterprises, researchers and field-specific ministries (incl. Ministry of Social Affairs, Ministry of Agriculture, Ministry of the Environment) and, if necessary, also other authorities or partners in the discussions of working groups for specific fields of growth. Activities will be planned and proposals made to the steering committee through close cooperation with enterprises (i.e. the entrepreneurial discovery process).
- A more detailed description and division of tasks of the management, monitoring and coordination system of smart specialisation will be set out in the implementation plans of the RDI strategy and the entrepreneurship growth strategy, along with the general coordination system of the strategies.

5.3. Implementation of the strategy

- The strategy will be implemented on the basis of an implementation plan where specific activities have been presented in terms of years and persons in charge and their cost over four (1+3) years. The implementation plan covers the launching of national RD programmes.
- The implementation plan will be prepared during the planning of the state budget strategy (SBS). In their SBS requests, ministries list the activities meant for the development of the planned RD (according to the classification of the functions of government (COFOG)) and fields of growth.
- The Minister of Education and Research submits a draft implementation plan to the Government of the Republic for approval not later than within three months of the approval of the strategy, and every year during the planning of the SBS. The RDC discusses the implementation plan before approving the SBS. If necessary, the implementation plan can be modified after the approval of the state budget.

5.4. Monitoring

- By 1 March each year the MoER submits to the Government of the Republic an overview of the implementation of the development plan, the achievement of the objectives and main indicators and the efficiency of the measures, also making proposals for additions and amendments to the development plan, if necessary. The report sets out:
 - activities for supporting fields of growth,
 - RD related to the achievement of socio-economic objectives in ministries according to the COFOG.
- The comparison is made mainly on the basis of international statistics. In the case of indicators where this is not possible, methods will be developed for their measurement and the determination of target levels. Statistics Estonia establishes statistics on government budget appropriations or outlays allocated to R&D (GBAORD) according to the OECD method.
- For the purpose of current monitoring of the results of the programmes implemented on the basis of the strategy, sets of indicators will be developed in cooperation with responsible ministries and implementing authorities, which will be used for the annual data collection and analysis.
- The monitoring activities of smart specialisation will be organised by the Estonian Development Fund.

5.5. Financing

- The financing of research and development from the state and local budget will be raised by 2015 to 1% of GDP²² and thereafter it will be maintained at that level.
- The share of private sector RD expenditure financed by the Government will be maintained at the achieved level²³.
- In order to finance the activities of the strategy, the resources of the EU Structural Funds will be used particularly in the implementation of structural change, securing activities not financed to date from state tax revenue, and also in the achievement of other objectives set out in the legislation on the Structural Funds. Activities that require continuous financing will begin to be gradually supported from tax revenue. No later than in 2018, the preparation of the implementation plan must set out the plan for exiting the financing scheme of the EU Structural Funds.

Indicative financing of RDI strategy, by measure and year

	2014	2015	2016	2017	2018	2019	2020	TOTAL
Measure 1. Ensuring a high level and diversity of research	132,379,614	104,479,147	97,940,183	111,064,001	118,959,840	120,928,994	114,880,930	800,632,708
Ministry of Education and Research	129,523,158	101,194,525	95,070,473	106,276,002	114,571,269	116,522,509	110,710,202	773,868,137
Ministry of Social Affairs	408,530	408,530	408,530	408,530	408,530	408,530	408,530	2,859,710
Ministry of the Interior	2,447,926	2,876,092	2,461,180	4,379,469	3,980,041	3,997,955	3,762,198	23,904,861
Measure 2. Increasing the social and economic benefit of RD	27,879,537	34,438,044	41,079,545	40,777,997	40,148,207	36,960,564	29,007,188	250,291,082
Ministry of Education and Research	15,258,744	13,895,168	10,012,702	10,946,154	11,605,743	12,318,100	12,764,724	86,801,335
Ministry of Economic Affairs and Communications	9,125,000	17,375,000	27,500,000	26,500,000	25,000,000	21,000,000	12,500,000	139,000,000
Ministry of Social Affairs	1,995,793	1,917,876	2,066,843	1,781,843	1,942,464	1,942,464	1,942,464	13,589,747
Ministry of Defence	1,350,000	1,100,000	1,350,000	1,400,000	1,450,000	1,550,000	1,650,000	9,850,000
Ministry of the Interior	150,000	150,000	150,000	150,000	150,000	150,000	150,000	1,050,000
Measure 3. Smart specialisation is the basis for RDI in changing the structure of the economy	23,561,702	22,473,057	31,111,022	35,708,038	37,971,840	36,798,311	20,824,781	208,448,750
Ministry of Education and Research	18,370,672	13,536,964	12,294,118	16,764,706	19,000,000	17,826,471	12,852,941	110,645,871
Ministry of Economic Affairs and Communications	2,000,000	6,000,000	16,000,000	16,000,000	16,000,000	16,000,000	5,000,000	77,000,000
Ministry of Social Affairs	3,191,030	2,936,093	2,816,904	2,943,332	2,971,840	2,971,840	2,971,840	20,802,879
Measure 4. Increasing the participation and visibility of Estonia in international RDI cooperation	9,882,400	13,812,081	11,833,162	15,086,589	15,263,949	15,439,901	12,524,903	93,842,985
Ministry of Education	9,547,360	13,437,041	11,406,122	14,609,549	14,753,949	14,909,901	11,974,903	90,638,825

²² According to Estonia 2020 action plan for 2011-2015,

(http://valitsus.ee/UserFiles/valitsus/et/riigikantselei/strateegia/ b konkurentsivoime-kava_b / b eesti-2020-strateegia/Eesti%202020%20%282012%20Quendamine%29/Eesti%202020%20tegevuskava.pdf).

According to Statistics Estonia, the financing of RD expenses from the state and local budget formed 0.79% of the GDP in 2011

²³ According to the OECD, the share of RD expenses of the private sector financed by the Government in Estonia amounted to 11.1% in 2010 and 8.9% in 2011

and Research									
Ministry of Social Affairs	5,040	5,040	27,040	27,040	30,000	30,000	30,000		154,160
Ministry of Defence	330,000	370,000	400,000	450,000	480,000	500,000	520,000		3,050,000
TOTAL OF ALL MEASURES	193,703,253	175,202,328	181,963,912	202,636,625	212,343,836	210,127,769	177,237,802		1,353,215,525
Ministry of Education and Research	172,699,934	142,063,697	128,783,415	148,596,411	159,930,961	161,576,980	148,302,770		1,061,954,168
Ministry of Economic Affairs and Communications	11,125,000	23,375,000	43,500,000	42,500,000	41,000,000	37,000,000	17,500,000		216,000,000
Ministry of Social Affairs	5,600,393	5,267,539	5,319,317	5,160,745	5,352,834	5,352,834	5,352,834		37,406,496
Ministry of Defence	1,680,000	1,470,000	1,750,000	1,850,000	1,930,000	2,050,000	2,170,000		12,900,000
Ministry of the Interior	2,597,926	3,026,092	2,611,180	4,529,469	4,130,041	4,147,955	3,912,198		24,954,861

6. INDICATORS USED

Indicator	Target level of the indicator				
	2010	2011	2012	2020	EU level
General aim					
Level of investments in research and development, % of GDP ^{1; 2}	1.62%	2.41 % ¹		3%	EU2011: 2.03%
incl. level of private sector RD investments, % of GDP ^{1; 2}	0.81%	1.52% ¹		2%	EU2011: 1.26%
Productivity of enterprises per employee compared to EU27 average, % ^{1; 2}		68%		80%	EU2011: 100%
Position in the Innovation Union Scoreboard ³			14(2013)	10	
Objective I: Research in Estonia is of a high level and diverse					
Number of PhDs awarded in an academic year ⁶	175	250	190	300	
Share of high-level articles in Estonia among the 10% of the most-quoted research articles in the world ^{3; 7}	7.5% (2008)			11%	EU2008: 10.9%
Number of high-level articles per million residents ^{1; 8}	1,125	1,174	1,191	1,600	EU2012: 1,310
Objective II: Research and development functions in the interests of the Estonian society and economy					
Share of public sector research and development costs financed by the private sector ^{1; 2}	3.9%	3.1%		7%	EU2010: 7.01%
Share of expenses aimed at socio-economic applications ^{1; 2} (except academic studies) from the RD appropriations planned in the state budget		~ 30%		40%	EU2008-2010: 43.1-44.6%
Objective III: RD makes the structure of the economy more knowledge-intensive					
Share of high-technology products and services in exports, % ^{1; 2}	10.4%	14.9%		15%	EU2011: 15.4%
Share of employment of high- and medium-high-technology sectors in total employment, % ^{1; 2}	6.0%	6.9%		9%	EU2011: 8.3%
Objective IV: Estonia is active and visible in international RDI cooperation					
The success of Estonia in EU research and development framework programme Horizon 2020: volume of contracts won per resident, % of EU average, where EU average = 100 ^{1; 9}			87%	100%	EU2013: 100%
Share of internationally coordinated research in state-financed RD ¹	1.31%			3%	EU2010: 3.8%

Source: ¹ Eurostat; ² Statistics Estonia; ³ Innovation Union Scoreboard; ⁴ Overviews of implementation of the "Europe 2020" strategy; ⁵ OECD; ⁶ Estonian Education Information System EHIS; ⁷ Scopus/Science Metrics; ⁸ Thompson Reuters Web of Science; ⁹ Horizon 2020 database.

7. ABBREVIATIONS USED

MoER Ministry of Education and Research

IPC innovation policy committee

EU European Union

OECD Organisation for Economic Co-operation and
Development

SBS state budget strategy

GDP gross domestic product

RD research and development

RDI research and development and innovation

RDC Research and Development Council

TIPS Research and Innovation Policy Monitoring
Programme

RPC research policy committee

8. APPENDIX. SWOT ANALYSIS OF THE RESEARCH AND DEVELOPMENT AND INNOVATION SYSTEM IN ESTONIA

Strengths

- A functioning and developing RDI system based on quality competition, and a support structure for the business sector
- Modernised environment
- Good development dynamics, substantial capacity for successful use and implementation of investments
- Innovative society
- Strong and developing researcher groups

Weaknesses

- Low income level of the Estonian economy, i.e. its low position in international value chains
- Uneven capacity in the management and coordination of field-specific research and development. Minor role of ministries in determining societal needs
- Insufficient motivation and capacity for cooperation between universities and enterprises
- Coordination problems, lack of unity, RD financing statistics do not support field-specific management
- Lack of critical mass in many fields, which becomes restrictive
- Very dominantly project-based, not output or quality-based
- Little interest among research-capable firms (mostly foreign-owned) in commissioning development projects in Estonia

Threats

- Brain drain
- Critical mass vs field-specific coverage problems, incl. to ensure the objectives of education and the Estonian language and culture
- Separation of research from the economy and society, as a result of which the social benefit (efficiency) of RDI is low. Excessive focussing of the research system on public money, little effort made to attract private money
- Focussing on domestic issues, little attention paid to foreign issues, inability to agree on major issues (strategic choices)

- The status of the economic structure of Estonia as a subcontracting country of little added value, a slow-moving EU Member State (“potato republic”)

Opportunities

- Regard RDI policy as a means for the achievement of economic and social objectives, incl. for changing the structure of the economy
- Use EU resources smartly
- Achieve critical mass and greater competence through international cooperation, incl. through the initiatives of the European Research Area and common research programmes and infrastructure of the Baltic countries
- Use world technology in Estonia in a new way, search for and implement niche opportunities
- The state must be smart in its commissioning of research, and as a user
- Take advantage of opportunities created by the migration policy in a smart manner
- Implement successfully new ways of research – e-infrastructure and dispersed infrastructure, use open access research data and results
- Raise more private capital (incl. from abroad)