

Peer review of the Icelandic Research and Innovation System

Time to take responsibility and act!

Expert Group Report prepared for the Icelandic Ministry of Education, Science and Culture and the European Research Area Committee.

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1 THREE KEY MESSAGES TO THE ICELANDIC GOVERNMENT

The underlying report intends to provide a series of reflections that should benefit Iceland's future actions in science, technology and innovation (STI). The Expert Panel ('the Panel') was heartened by the fact that the large majority of (potential) problems and challenges as well as the potential solutions seem to be well known to the Icelandic officials. It became very clear to the Panel that the real challenge for Iceland is to bring these about, albeit in a difficult socio-economic climate. Taking no action at all is a strong decision in itself but this is no longer an option if the Icelandic Government wants to ensure future economic growth and societal wellbeing. Postponing clear and strong short term actions is expected to further damage the STI system and its performance, and will lead to a major loss of confidence.

We list below three key messages to Icelandic policy makers and politicians (further supported by a number of underlying recommendations made throughout this report):

1. ***Political commitment and action are urgently needed...***

The government of Iceland should put STI higher up on the political agenda, organise a parliamentary discussion on STI, listen to and hear the actors in the system, take stock of the underlying and previous reviews, design a roadmap with tasks and responsibilities, and take action! In particular, the high insitutional fragmentation (hence inefficiency) of the STI system needs immediate corrective action. The solutions seem to be well known in Iceland and courage is now required in order to take the decisions. The PM's office, heading the government and chairing the STI Policy Council, is the right actor to take this initiative. After taking the most urgent actions to get the STI system on the right track, the Icelandic government should ensure the follow-up of the actions implemented and increase the flexibility of the system to adjust for further changes.

2. ***Change is required at all levels, also from the actors in the system....***

Iceland seems to be in the middle of what can be called a 'prisoner's dilemma'. This refers to situation where the key actors in Iceland (universities, research insitutions and industry) could gain important benefits from cooperating, but simply find it difficult or expensive, but not impossible, to coordinate their activities to achieve cooperation. Acceptance of the reality of challenges, awareness of reasons for the changes is STI environment and behavioural changes are needed to address this. The Panel urges all actors in the system to stand-up and take a (joint) initiative on their level. The STI Policy Council should invite all actors to make proposals in writing on where they see 'budget neutral' collaboration possibilities and what the expected effects might be.

3. ***Invest in evidence, evidence, evidence...***

There is an enormous lack of evidence on the efficiency and effectiveness of STI policy measures, leading to a lack of transparency and accountability towards each other (in the system) but also towards society at large. Subsequently, this leads to the oft-mentioned 'lack of trust' in the system. The Panel emphasises the need to build up evaluation and impact assessment expertise, and put this expertise into practice (ex-ante and ex-post). Furthermore, systematic publication of main data, indicators, and assessments by all STI actors on an official website increases the awareness of the overall situation in Iceland and hence the openness of the system, thereby allowing more targeted actions on all levels. The STI Policy Council should make this a strategic priority and make the necessary investment propostions.

2 RECOMMENDATIONS VIS-À-VIS TIMING AND PROPOSED LEAD ACTOR

In the table below, an integrated overview of all recommendations made to the Icelandic government is provided.

The table contains a reference to the recommendation (R-number) described in the report, along with the actor, who according to the Panel, should take the lead in the implementation process, and a proposed time-frame for implementation. The overview may also serve as a basis for the future monitoring of progress.

	Immediate/short-term (<2 years)	Mid-term (2-3 years)	Long-term (>3 years)
STI Policy Council	R4, R8, R12, R14, R15, R16, R17, R19, R27, R34	R3, R5, R7, R18, R20, R21, R32, R33, R35, R36, R42	R25
PM as chair of the Council	R1, R9, R10, R11		
Min. Education, Science and Culture	R6, R8, R38, R40	R2, R13, R26, R39	
Min. of Industries and Innovation	R6, R8, R37	R13, R26	
Min. of Finance and Economic Affairs	R29, R31, R30		
Universities		R3, R22, R23, R24, R28, R41	R25
RPOs		R3, R22, R24, R28	R25
Federation of Icelandic Industries	R34	R24	R25
Rannís		R33	

A full discussion of the recommendations is provided in the following chapters.

3 GENERAL BACKGROUND

3.1 Introduction

In October 2010, the European Commission's Europe 2020 flagship initiative Innovation Union¹ reaffirmed the role of peer reviews in support of reforming national research and innovation systems. It also invited Member States to carry out self-assessments based on the methodology described in its Annex². The objective of the Member States' self-assessments is to identify key challenges and critical reforms as part of their National Reform Programmes.

In 2013, after a series of 'pilot' reviews in different countries (Belgium, Estonia and Denmark), Iceland requested a peer review of its research and innovation system. The country has a long history and tradition with respect to 'peer' or 'external' review of different parts of its socio-economic policy domains, including science, technology and innovation policy. Two key and detailed reviews are the OECD review in 2005³ and the Taxell Report in 2009⁴. Both reports have had noticeable impact on STI policy in Iceland.

As indicated in the Self-Assessment Report (see Annex 2), *"with this EC peer review, the Icelandic Government seeks to receive feedback and expert evaluation on the current status of science and innovation issues in Iceland as well as external advice in its efforts of enhancing the national innovation capacity and promoting increased excellence in research. The self-assessment process serves to provide the research and innovation community in Iceland with the opportunity to discuss and define the main issues at stake."* The results of the review process are expected to feed into the operationalisation process of the new 2013-2016 STI strategy (developed by the Science and Technology Policy Council), a strategy that was adopted by the Council in December 2013 (i.e. before the start of the peer review process).

The entire review process has proven to be of great value from a number of perspectives. The internal preparation phase has shown the value added of the SAT-tool for facilitating a valuable process of 'internal' reflection on the organisation, efficiency and effectiveness of Iceland's research and innovation system. The interaction phase with the Panel has also proven to be of great value in mobilising, and providing a discussion and reflection platform for a wide range of stakeholders that do not interact with each other frequently enough (even in a small country like Iceland). The value of the review 'process' itself appeared to be of major importance. The underlying report presents the reflections of the Panel on a number of issues discussed, and provides recommendations and suggestions where possible and appropriate.

¹ http://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication_en.pdf COM(2010) 546 final; p. 28

² Annex 1 of the Innovation Union Communication presents the Self-Assessment Tool - SAT

³ OECD (2005), Policy Mix for Innovation Iceland, Directorate for Science, Technology and Innovation

⁴ Taxell, Christoffer, Richard Yelland, Iain Gillespie, Markku Linna, Arnold Verbeek. 2009. Education, Research and Innovation Policy. A New Direction for Iceland. Reykjavík: The Ministry of Education, Science and Culture.

3.2 The peer review process

3.2.1 *The peers and the preparatory phase*

After the candidacy of Iceland (the Ministry of Education, Science and Culture) to be 'peer reviewed' was agreed, a group consisting of John Dooley (Ireland), Francien Heijs (The Netherlands) and Riitta Maijala (Finland) was formed. The group was further complemented by an independent expert, Arnold Verbeek (IDEA, Belgium), who participated as country expert, but who was also charged (on behalf of the European Commission) with the overall coordination of the process. The coordination and preparation on the side of the Ministry of Education, Science and Culture was taken care of by Ásdís Jónsdóttir, in close collaboration with Þorsteinn Gunnarsson and Eva Diego Þorkelsdóttir from Rannís (the Icelandic Centre for Research). The European Commission (EC), as observer throughout the process, was represented by Diana Senczszyn.

The overall implementation process of the review is shown in the figure below.

Figure 1: Overview of peer review process



The process officially started in December 2013 with an introductory 'kick-off' meeting through videoconferencing, involving the Icelandic Ministry of Education, Science and Culture, the independent expert and the EC. The discussion focused on the general set-up, the preparation process and the expectations when moving towards the review.

In November Iceland started the self-assessment process and the drafting of the related report. The self-assessment process was led by the Ministry of Education, Science and Culture and built on a series of discussion meetings, structured in accordance with the Innovation Union Self-Assessment Tool (SAT). A working group convened by the Ministry of Education, Science and Culture met four times during the period from November 2013 to January 2014. The group was composed of representatives from the Prime Minister's Office; Ministry of Education, Science and Culture; Ministry of Industries and Innovation; Ministry of Finance and Economic Affairs; the Icelandic Centre for Research (Rannís); the Science and Technology Policy Council; as well as from business enterprises, universities and research institutions. In addition to these four meetings, an open meeting was held on January 28th 2014 where members of the science and innovation community were invited to contribute to the process.

The open meeting was well attended and the participants represented different parts of the science and innovation system. In addition, a number of people were consulted while the report was written in order to receive further input. The results of the meetings were processed, analysed and documented by the Ministry of Education, Science and Culture in collaboration with Rannís.

In **February 2014**, the independent expert visited Iceland and discussed in more detail the overall process, the preparation activities, the draft agenda for the interview phase in Iceland, as well as the first results of self-assessment process.

In **March 2014**, the peers met with the independent expert, the EC and Ásdís Jónsdóttir (from the Ministry) in Brussels. During this meeting, the peers acquainted themselves with the main characteristics of the Icelandic STI system, amongst other things, through a first discussion of the self-assessment results.

Finally, in **April 2014** (2-4 of April), the interview phase took place in Iceland (see Annex 1 for the full agenda of this two day meeting). The interim report was prepared in May 2014, and a feedback mission to Iceland is foreseen for **June 2014**.

3.2.2 Focus of the peer review

On the basis of the self-assessment the Ministry of Education, Science and Culture, identified five key questions which summarise the main challenges identified in the system. These questions are presented below (for more details, see Self-Assessment report, presented in Annex 2) and are discussed in more detail in the remainder of this report.

Question 1: How to optimise the links between science, technology, and innovation policy and its implementation (moving from policy planning to action and realisation)?

The main policy-making body on science and innovation in Iceland is the Science and Technology Policy Council (STPC). At the establishment of the Council in 2003, science and innovation policy was elevated to a higher political level and its importance for the more general economic and industrial policies recognised. A decade of experience with this system has, however, revealed weaknesses, especially in the link between policy-making and implementation. The key issue here is how to strengthen the implementation level of the periodic STPC strategy.

Question 2: How to build a more effective science and innovation strategy in a small country within a globalised world?

Iceland is a very small economy (the smallest of the OECD countries) with a fragmented STI system in need of more strategic prioritisation, collaboration and resource 'pulling' coherence and coordination. To illustrate this further, the total annual government contribution to R&D (spend by all sectors) is about EUR 110 million, which equals the annual R&D spending of a company like Prada (Italy), Husqvarna (Sweden) or Ahold (The Netherlands), companies that are ranked around the 600th position on the global R&D expenditure ranking⁵.

How (and even whether) to prioritise remains a debated question in Iceland. Some point out that with the limited resources of a very small country, it is even more important than in larger ones to prioritise 'intelligently'. Others state that Iceland should keep on building on the excellence that emerges from "the grass-roots". The debate on prioritisation or 'smart specialisation' is an ongoing one, not only in Iceland, but in most countries seeking to build up excellence in research and innovation. While there is not a single 'right' answer to this question,

⁵ Information based on the EC R&D Scoreboard, 2013.

the authorities welcome the peers' input into how to approach intelligent prioritisation in Iceland, particularly in light of the country's small size.

Question 3: How to promote and enable the growth of SMEs?

Iceland has a good general framework for entrepreneurs, and ranks high in comparative studies on early adoption of new technology. However, despite these strengths, growing companies face a number of challenges. Six years after the economic collapse in 2008, the Icelandic economy is still in recovery phase. Capital controls, implemented to prevent capital flight during the economic collapse, remain in place - creating difficulties for growing companies and preserving a sense of uncertainty about the future. Moreover, there is a lack of venture capital necessary for the growth of seed companies and start-ups. Whereas the conditions for the early development of new products and services are relatively good, many companies feel forced to move their operations abroad to more competitive environments once they grow beyond a certain size. One of the main aims of the policy of the STI Policy Council is to increase the share of private investments in R&D in the total R&D expenditures. In order to achieve this goal, Iceland needs to find ways to create a more competitive environment, despite the relative financial uncertainty and ongoing capital controls.

Question 4: How to increase innovation capacity throughout the educational system?

There are many opportunities for better coordination between the educational system and the needs of the industries in Iceland. In the knowledge-intensive industries, there is a lack of people with technical skills and expertise, and the proportion of university graduates from the natural sciences and technology is very low. Public expenditure on pre-primary and primary educational institutions as a percentage of GDP is comparatively high in Iceland. However, the investment in education seems to yield less than expected. In the past, Iceland has been losing ground in terms of young people's skills in reading, mathematics and the natural sciences, according to the OECD PISA survey. The mean score in reading and mathematics for 15 year-olds in Iceland is considerably lower than the OECD average, and has been decreasing. At the tertiary level, the opportunities for PhD studies and young researchers have grown rapidly in recent years. While young researchers benefit from the high level of excellence in many research areas in Iceland, the organisational environment for PhD students and post-docs is still underdeveloped.

Question 5: How to strengthen relations between SMEs, research institutions and higher education institutions?

Assessments of the research and innovation system in Iceland have repeatedly pointed out that the system is fragmented and that there is space for much more collaboration between public and private actors. Many outstanding examples of successful collaboration exist, for instance within fisheries research, but this is relatively unsystematic and ad hoc, dependant to a large extent on the initiative of specific individuals. There is a need for schemes and actions that encourage collaboration and the ongoing transfer of technology.

3.3 Iceland and the post-economic crisis era

Iceland still finds itself in the aftermath of an unprecedented economic and social crisis. In order to prevent severe capital outflows and the excessive devaluation of the currency, capital controls were introduced in October 2008 at the time of the onset of the financial crisis. Six years later, the capital controls are still in place. Because they tend to reduce the supply of capital, raise the cost of financing and increase financial constraints, long-term capital controls pose a challenge for companies, particularly small, growing firms and those that do not have access to international capital markets⁶. One of the effects of the economic crisis has been reduced investment. After 2008, the investment/GDP ratio dropped considerably and was only 13% in 2010 compared to 21% which was the 1980-2011 average. The ratio is among the lowest in the OECD and the post-recession investment increase has also been slower than the OECD average⁷. Moreover, there is (and has historically been) very little direct foreign investment in Iceland. High interest rates serve to further discourage investments. Because of the current economic conditions, many seed ventures and start-ups are forced to move abroad in order to secure venture capital. In the long term, this results in loss of jobs and reduced economic growth in Iceland. Due to the budget cuts, 'across the line' general salary levels (and the purchasing power of salaries) have been decreasing along with increasing unemployment, leading to the top-talent moving away from Iceland. There are clear indications that highly-skilled workers are overrepresented among those Icelandic citizens who have emigrated (e.g. in case of physicians).

In the years after the economic crisis, the STI Policy Council developed a new strategy for 2010-2012 in which the Council became more prescriptive by putting forward a number of strong views and clear policy directions. Despite the effects of the economic crisis, Iceland introduced a tax reduction scheme for R&D projects in businesses in 2010. At the time, the Council asked for further evaluation in order to build evidence-based policies, to put more emphasis on competitive funding in order to increase excellence and to support non-technological innovation.

Icelanders are hard-working, creative and entrepreneurial and have proven to be quite resilient by nature. Immediately after the economic crisis in 2008, a lot of so-called 'grass root' initiatives were launched to develop new ideas and create new market opportunities. Although policy makers have intended to minimise the effects of the budget cuts on education, research and innovation, being aware that these policy areas could provide a way out of the crisis, major cuts could not be avoided. Despite good intentions, budgets had to be cut (on average 15-20%) in some policy domains for several consecutive years. For example, in the area of Higher Education, this has led to structural under-funding, the implications of which are becoming visible today.

It is against this background that the peer review process and report have to be considered, a background that is characterised by a number of structural problems and challenges that make policy making in Iceland today a rather daunting task.

⁶ Forbes, Kristin J. 2007. The Microeconomic Evidence of Capital Controls: No Free Lunch. NBER Working Paper Series. Cambridge, MA: National Bureau of Economic Research.
http://www.nber.org/papers/w11372.pdf?new_window=1

⁷ Central Bank of Iceland. 2012a. Rammagrein 1-2: Fjárfesting í kjölfar efnahagskreppa. Peningamál, 50. rit: 17-19.

4 REFLECTIONS BY THE EXPERT PANEL

4.1 Introduction

During the interview phase in Iceland, each session (corresponding with one of the five key questions) was opened by one or more presentations by the participants. After the presentations the floor was open for discussion involving all the session participants. The discussions were often broad-based, touching upon a variety of systemic issues, as it became apparent that there is a high interrelation between the five key review questions.

The Panel was impressed by the large number of participants and the high quality (depth and breadth) of the discussions. The participants were engaged and highly motivated to contribute. As the review proceeded, the Panel realised that the Icelandic STI community is very well aware of the major problems and the potential solutions and that the key challenge faced is one of 'making it happen'. The focus needs to be about identifying (and making explicit) responsibilities and accountability and about taking action on different levels, starting with the self-organisation of the actors themselves. It seems to the Panel that for several key issues it is already '5 to midnight' if not '5 over midnight'.

4.2 About the 'fundamentals'

The performance of a country's science and innovation system depends strongly on the presence or absence of a number of 'fundamentals'. These fundamentals reflect the organisation of the system and its governance, including the importance put on STI policy in general. The Panel identified a number of fundamentals that are currently not or only partially in place, and which are important in order to make things happen.

4.2.1 *Fundamental 1: Political will and support to STI reforms and investments*

Fundamental to a successful STI policy is recognition and support from the highest policy making circles, particularly by elected politicians. The Panel has the impression that some Icelandic politicians (there are of course exceptions) do not sufficiently recognise the importance of STI policies and the associated investment decisions and actions that are required. What contributes to this is most likely the fact that STI may not be the hottest societal (hence political) issue at the moment, plus perhaps a lack of awareness about the socio-economic role and potential of the STI investment. Politicians, across policy domains, need to lead the way in making the STI Council's strategy become a reality, as STI is one the main drivers of Iceland's current and future societal and economic success.

The Panel suggests the following actions (recommendations):

- R1. Immediate/short-term action:** *Organise a debate/hearing in the parliament (or the parliamentary subcommittees) on the role and importance of STI, the bottlenecks faced, and the actions needed. Show politicians that a strong STI system and policy will benefit the future of Iceland. Suggested Lead: Prime Minister, as chair of the STI Policy Council and head of the Government of Iceland*
- R2. Mid-term action:** *Establish that it is the responsibility of the research organisations to provide material explaining their impact for the Icelandic society (e.g. in annual reports, brochures, website) and to deliver it to their major stakeholders. Suggested Lead: Ministry of Education, Science and Culture; Ministry of Industries and Innovation (as parent ministries)*

R3. Mid-term action: *Develop appropriate communication material and communicate the importance of STI to the broader public (e.g. through TV or newspapers) in order to make STI a public issue of concern, and hence of political concern and importance. Suggested Lead: STI Policy Council, RPOs, Universities*

4.2.2 Fundamental 2: Future-oriented vision and strategy

The work of the STI Policy Council has been of major importance and influence in bringing together key actors around STI policy issues and by putting difficult topics on the agenda. The new 2013-2016 strategy of the STI Policy Council (adopted in December 2013) contains many important and relevant suggestions and recommendations. Nevertheless, the strategy in its current form lacks a long-term vision for Iceland. Without this there is lack of an ambition and clear choices, the ability to guide, steer and motivate actors in the STI system. At the same time, it also lacks the concreteness and a 'reality check' (e.g. in budgetary terms) in order to be seen as an operational short-term action plan. In other words, the 'strategy' is currently a mix between a vision document and an implementation plan and lacks the necessary level of inspiration in terms of where Iceland is heading and what Iceland wants to be known for (more on this in the subsequent sections).

R4. Immediate/short-term action: *The STI Policy Council needs to develop and communicate a long term (4-6 year) vision for Iceland with respect to the national STI investment, structures and goals achievable with the budgetary constraints. This vision needs to be ambitious and broadly supported by all levels of government, to be aligned with other policy domains, and to be reviewed periodically. The vision should moreover be based on and driven by Iceland's economic and societal challenges and needs, and should also reflect the type of economy and growth models it envisages for Iceland. Input from all the ministries, industry and research community should be requested in order to arrive at a common vision. Suggested Lead: STI Policy Council*

R5. Mid-term action: *Based on this long-term vision as a guiding framework, the STI Policy Council should subsequently develop annual or bi-annual roadmaps and action plans, based on the inputs of the different ministries, with clear objectives (that should be SMART⁸), deliverables and milestones, and responsible actors towards implementation. Roadmaps should be developed in close collaboration with the ministries in order to ensure the implementation of the actions. However, specific care should be taken not to allow the prevailing 'stand still' attitude to proceed but to keep the long-term vision as the guiding role. These action plans have to lead to short-term policy declarations that should guide short-term policy making. Suggested Lead: STI Policy Council*

4.2.3 Fundamental 3: Transparency, responsibility and accountability

Transparency, responsibility and accountability are three very important prerequisites for a well-functioning STI policy system. Transparency refers to clarity on who fulfils which role in the system. Responsibility (of different actors at different levels) and accountability (through objective evaluation and assessment) refer to the definition and allocation of clear responsibilities and the assessment of how these responsibilities are taken up. The Panel has the impression that improvements are possible in these respects and welcomes (in line with R5) the further operationalisation of the STI Policy Council's strategy into an action plan, including a roadmap, with clear actions and allo-

⁸ Specific, Measurable, Attributable, Relevant and Time dependent.

cation of responsibilities. This can be the first good practice example of how the relations between the different actors and stakeholders need to be managed in the future.

R6. Immediate/short-term action: *Ensure that the current knowledge of the performance and resources available for each RPO are transparently distributed to the key stakeholders and is made public through their websites. This would include e.g. annual agreements and how targets have been met, number of publications and level of journals they were published, share of external research funding out of the total budget of the organisation etc. Suggested Lead: Ministry of Education, Science and Culture; Ministry of Industries and Innovation (as parent ministries)*

R7. Mid-term action: *Actions to increase transparency and openness should be assessed and included within the next STI strategy. This includes e.g. input and output indicators of research organisations, principles of allocation competing funding etc. Suggested Lead: STI Policy Council*

4.2.4 Fundamental 4: Evidence-based policy making

In the previous assessments of Iceland's STI governance⁹, ample attention has been paid to the need for evidence on the efficiency and effectiveness of support instruments and measures. The Panel echoes these previous assessments and again signals the absence of evidence-based policy making for STI policy in Iceland, with some minor exceptions (e.g. the recent evaluation of the Technology Development fund). The decision-making bodies lack important and essential information on which they could take well-informed decisions. A well-developed policy cycle includes the phases of policy design, implementation, monitoring, evaluation (and impact assessment) and redesign. Evaluation and impact assessment are on one side of the coin, and the other is strategic intelligence on what is happening 'around' Iceland and how this may or should change STI policy in Iceland. The Panel has the impression that the STI policy support system is strongly under-developed (e.g. the Ministry of Education, Science and Culture currently only has four full-time advisors who have to follow national and international developments in STI).

R8. Immediate/short-term action: *In line with previous recommendations and suggestions, urgent professionalisation of the overall STI policy support system (including support to the activities of the STI Policy Council) is needed. This support system should encompass evaluation capability and expertise (ex-ante and ex-post), including impact assessment and the international intelligence needed to source policy relevant knowledge. E.g. no policy measure should be launched without a thorough ex-ante evaluation on its cost-benefit ratio. Suggested Lead: Ministry of Education, Science and Culture, Ministry of Industries and Innovation, and the STI Policy Council*

⁹ E.g. Taxell, et al., 2009; OECD, 2005; various annual TrendChart Innovation policy assessments of Iceland.

The Netherlands: Standard Evaluation Protocol 2015-2021

The Standard Evaluation Protocol (SEP) describes the methods used to assess research conducted at Dutch universities and NWO and Academy institutes every six years, as well as the aims of such assessments. Three key assessment criteria are considered: 1) research quality, 2) relevance to society, 3) viability. The entire Protocol can be downloaded here: <http://www.nwo.nl/documents/nwo/juridisch/standard-evaluation-protocol-2015-2021>

Ireland: Forfás Evaluation of Enterprise Supports for Research Development and Innovation

Since 2012, Forfás has undertaken a detailed programme of evaluations of supports provided by the Enterprise Agencies in Ireland. These evaluations are structured under the themes of entrepreneurship and start-up supports; research, development and innovation; and business development and have been undertaken in line with the Forfás evaluation framework, which is based on international best practice. This suite of evaluations covers research, development and innovation programmes provided by Enterprise Ireland, IDA Ireland and Science Foundation Ireland.

The 2014 report can be downloaded here: <http://www.forfas.ie/publication/search.jsp?ft=/publications/2014/Title,12145,en.php>. Particular attention should be paid to Appendix 5 (p. 345) that gives the overall framework for the evaluations.

4.3 From planning to action: challenges in the governance of science and innovation

4.3.1 *Introduction*

The key governmental body in charge of the design and coordination of STI policy in Iceland is the Science and Technology Policy Council of Iceland, chaired by the Prime Minister. The establishment of the Council resulted from a new legislation in 2003 on the organisation of science and technology policy and the funding of research and technological development. The Council is inter-ministerial and is headed by the Prime Minister. Other ministers with a permanent seat are the Minister of Finance and Economic Affairs; the Minister of Education, Science and Culture; and the Minister of Industries and Innovation. In addition to these, up to four additional ministers may be specifically appointed by the Prime Minister. Currently, the Minister of Welfare and the Minister for the Environment and Natural Resources also hold a seat in the Council.

The role of the Council is to define the strategic orientations for STI development policy in Iceland. The Council took its first term of office for the period 2003-2006. A new strategy for 2013-2016 has recently been adopted (November 2013). The Council holds three to four meetings a year. Two working committees, the Science Committee and the Technology Committee operate under the Council. The secretariat of the Council lies within the Ministry of Education, Science and Culture and is supported by the Ministry of Industries and Innovation. The main instruments supporting the Council's policy are:

- Science side: the Research Fund that is closely linked to the Infrastructure Fund, sharing the same board. The board is appointed by the Ministry of Education, Science and Culture.
- Technology side: the Technology Development Fund, governed by a board appointed by the Ministry of Industries and Innovation.

STI policy is developed by the Council on the basis of collegiality and coordination among its members. Further operationalisation of the general policy is undertaken by the ministries themselves, who are largely independent and autonomous. Two main actors responsible for the implementation of the STI policy are Rannís, the Icelandic Research Centre (reporting to the ministry of Education, Science and Culture), and the Innovation Centre Iceland (Reporting to the Ministry of Industry). Rannís manages the international connections and monitors the effects and impacts of policies, although this activity has not been developed sufficiently so far.

Rannís manages (in operational terms) Iceland's main funds, including the Research fund and the Technology fund, although they are governed by the respective ministries. The individual ministries - and under them the various agencies and R&D institutes - also have a responsibility to implement the general policy (some of the ministries manage specific/dedicated R&D funds, like the Ministry of Fisheries).

The Icelandic Innovation Centre stimulates business development in Iceland through its IMPRA unit. IMPRA assists entrepreneurs nationally in evaluating business ideas and provides advice and courses for SMEs and the general public and provides popular support programmes for female entrepreneurs. Its role is to act as an intermediary between individuals, companies and public agencies. The sub-regional activities of IMPRA have intensified in recent years. IMPRA also operates an incubation centre (just as the University of Iceland does through its technology transfer activities) where seed companies are further supported. It is also the contact point for the Europe Enterprise Network.

4.3.2 Taking stock of the discussion

Different contributions were made on this topic from a variety of perspectives. While the STI Policy Council has been active for the past 10 years, it is the general feeling of all participants that many actions and resolutions delivered by the STI Policy Council have not been (or have only partially been) implemented. Examples include the resolutions on the competitive funds, which were originally intended to increase strongly, or the institutional simplification, where some results are visible. Lack of ownership of the resolutions is seen as one of the most important explanations for the lack of action. The STI Policy Council acts as an advisory body to the ministries where the real implementation power lies. There seems to be a divide and a distance between the Council and the ministries, despite the fact that the Council operates across ministries.

In general, it is acknowledged that coordination among ministries is problematic. This is due to the vertical nature of the ministerial structures and the anomaly of tackling horizontal challenges within vertical bureaucracies. The challenge is to create more horizontal coordination by providing discussion and interaction platforms and by stimulating horizontal coordination.

Another important aspect is believed to be the lack of harmonised data collection, evaluation and impact assessment. Both are considered to be of major importance for showing results, assessing the impact and adjusting policies in time. The participants do recognise the fact that for many initiatives there is simply no money (as a result of the economic crisis) or political will to prioritise and invest. A key role is played here by the Ministry of Finance, which is believed to be quite hesitant and sceptical towards STI initiatives as these are often considered as 'costs' instead of 'investments'. Finally, several participants also refer to a general lack of trust among different parties in the system allegedly blocking reform and action. This relates to the transparency and openness of

the system, which is a challenge in the country of this size where 'almost everybody knows each other'.

4.3.3 *Reflections of the panel*

The power of action in Iceland lies within individuals. All actors in the Icelandic system, which is comprehensible and small, have a responsibility to take action or try to shape the right environment in which action can take place. At the same time, a good support structure is needed. The Panel's impression is that the role, composition and hence power of the STI Council have a major influence on the lack of action:

"The Council appears so far not to have been able to fulfil the role of policy maker, perhaps due to the lack of commitment of its members, the lack of recognition by the system, the lack of adequate support in the sense of 'intelligence' provision (cf. the role of Rannís), and the existence of parallel decision mechanisms mainly located inside the ministries."¹⁰

This statement is still accurate and largely reflects some of the problems and challenges faced. The real issue is to ensure the take-up of proposed actions by the ministries for implementation. In order to ensure that the working committees and the STI policy Council have strong high-level members, that the Council's declarations should be made mandatory and that implementation should be assessed and monitored, ultimately by the government of Iceland. It is also strongly questionable whether the rather artificial split between a science and a technology committee (under the 'Science and Technology Policy Council') should be continued, as it may lead to two rather suboptimal policies and unnecessary complicated coordination.

R9. Immediate/short-term action: *Clarify and strengthen the role and membership of the S&T Policy Council in the system. The Council needs more power and recognition. If needed, adjust the 2003 legal framework. The Council is the STI policy making (and not 'advisory') body in Iceland! Suggested Lead: PM office as chair of the STI Policy Council.*

R10. Immediate/short term action: *Reconsider the composition of the Committees and the Council in line with the Taxell report recommendations. Suggested Lead: PM office as chair of the STI Policy Council.*

The Council should develop a long term strategy and vision (4-6 years) accompanied by annual or bi-annual action plans, or declarations (see also R3 and R4). As already indicated above, the long-term vision should be inspiring and reflect the way ahead for Iceland, based on the identification of societal needs and challenges, while safeguarding space for 'grass root' actions and experimentation. The action plans should contain a clear roadmap with objectives that are SMART (Specific, Measurable, Attributable, Relevant and Time-dependant) and that have been linked to the necessary resources. The Council should manage the expectations better in order to have fewer objectives that can be realised than many that cannot. This is important for the credibility of the Council in the system.

Also important is the way in which the strategy and the action plans are developed. The ministries, with STI in their portfolio, should be invited to present their STI relevant strategy to other colleagues in the Council. Based on this, the Council should proceed with the development of an integrated vision and the associated integrated action plans. The Council should give its formal approval to a ministerial STI related action plan. Subsequently, the Council will periodically monitor and assess progress.

¹⁰ Taxell et al., 2009.

R11. Immediate/short-term action: *The strategy and the actions plans should be developed bottom-up: ministries should prepare their STI related strategy and action plan, and present them to the entire STI Policy Council. Subsequently, a common strategy and action plan should be agreed upon, with SMART objectives and clear responsibilities. Ministerial action plans, related to STI, should be approved by the Council prior to implementation. Suggested Lead: PM office as chair of the STI Policy Council.*

Evidence, evidence, evidence! Without the right evidence, the right policy cannot be set-up and implemented, and its results and effectiveness (or the lack thereof) cannot be proven. The evidence-making system needs to be strengthened as soon as possible. Policy making is about making choices, certainly in the case of Iceland, but on what basis can choices be made if there is no evidence? The Panel believes that because of this lack of evidence and transparency, suboptimal policy measures are continuing, while potentially optimal ones do not get a chance of implementation. At the same time, evidence collection should be a focussed process, focussing on the expected effects of measures and the identified data gaps. There is no point in measuring if there is not clear strategy and finality regarding what will be done with the results.

Finally, it is equally important to explicitly note that the STI Policy Council cannot solve all the problems in the Icelandic STI system. It is the responsibility of the STI Policy Council to decide, guide and steer, while it is the responsibility of the individual actors in the system to take initiative, to get organised, and to make suggestions to the Council on how to proceed. The impression of the Panel is that there is enough potential to tackle numerous challenges within the existing overall framework. Courage and willingness apply to politicians and policy makers, but also the actors within the STI system.

R12. Immediate/short-term action: *To the STI actors themselves - take responsibility, reach out and act within your context and on your level. A series of 'problem solving' roundtables should be organised on each (or a selection) of the topics touched upon in this review report. Solutions should be ranked and proposed to the STI policy Council for decision. Suggested Lead: STI policy Council committees and secretariat*

R13. Mid-term action: *Ensure that RPOs will make publicly available their key expertise, input and output and communicate this to key stakeholders. Suggested Lead: Ministry of Education, Science and Culture; Ministry of Industries and innovation (as parent ministries)*

4.4 Intelligent proactive prioritisation: governing a small country in a globalised world

4.4.1 Introduction

Iceland is a (very) small economy with limited financial capabilities in the area of STI; it is one of the smallest OECD countries. In this respect it is a credit to Iceland that it has built up a fully-fledged innovation system that performs very well on different dimensions (see Annex 3). Nevertheless, limited resources in absolute terms means that some kind of focus and prioritisation are needed in order to make a difference in our globalised world.

Prioritisation knows many faces, from thematic research prioritisation to funding and the way funding is distributed (block versus competitive). As in other countries (and regions), not all necessarily with limited resources, there is an ongoing debate in Iceland about the extent to which STI funding should be subject to prioritisation. Iceland has

made some concrete choices in the past although not always in line with internal strengths and the presence of a clear value potential (e.g. by considering the position of Iceland in the ecosystem or the value chain).

In 2007 a foresight exercise was carried out under the auspices of the Council. The priority areas selected through this foresight exercise were: 1) natural resources, environment, and sustainable development, 2) health and wellbeing, 3) strengths of a small nation, and 4) industries, trade and funding of knowledge production and innovation. Based on the results of this exercise, the Council called for project proposals in relation to 'Centres of Excellence' and 'Research Clusters' to be funded for up to 7 years with an annual maximum budget of about EUR 500,000. In February 2009, three projects were selected: The Icelandic Institute for Intelligent Machines – IIIM, The Geothermal Research Group, and The Centre of Excellence in Gender, Equality and Diversity Research.

On the European level, 'smart specialisation' is an ambition (and an obligation for draw-down of R&I Structural Funds 2104 - 2020) of many regions: "*Smart Specialisation is a strategic approach to economic development through targeted support for research and innovation. It involves a process of developing a vision, identifying the place-based areas of greatest strategic potential, developing multi-stakeholder governance mechanisms, setting strategic priorities and using smart policies to maximise the knowledge-based development potential of a region, regardless of whether it is strong or weak, high-tech or low-tech*¹¹."

Smart Specialisation is in line with the Commission's overall growth strategy, EU 2020, and its response to the ongoing economic crisis, including a focus on identifying niche areas of competitive strength, solving major societal challenges (bringing in a demand-driven dimension), innovation partnerships emphasising greater co-ordination between different societal stakeholders and aligning resources and strategies between private and public actors of different governance levels. The European Commission launched the Strategies for Smart Specialisation Platform (S3 Platform) in June 2011 to provide professional advice to EU member states and regions for the design of their Research and Innovation strategies for smart specialisation. The Platform is an in-house service of the Commission, located at the Institute for Prospective Technological Studies (IPTS) in Seville, which is one of seven institutions that form part of the DG Joint Research Centre (JRC)¹².

4.4.2 Taking stock of the discussion

Key elements that were brought forward during the discussion are the low level of competitive funding (about 20% today) versus block funding, the small size of the grants that are provided and the overall fragmentation. Another issue relates to the competition for funding where, in one case, the sciences had been competing with engineering, which was considered to be unfair. From this perspective, overall thematic prioritisation was considered necessary by all participants. Larger grants need to be provided in clearly chosen thematic areas. Clearly, prioritisation is relatively easier with additional financial resources, but this is problematic in Iceland today.

The participants indicate that Iceland is already prioritising in different ways. For example, it was noted that the universities do focus on particular research areas. There is awareness about the importance of scientific excellence in building up new industries, hence attracting companies and people. Also, with respect to the Technology Development Fund, the majority of grants here go to industry, and in particular to projects that focus on research commercialisation. While the Research Fund has been focusing on more basic types of research project, a dichotomy or 'gap', between the two funds has

¹¹ <http://www.nordregio.se/en/Metameny/Nordregio-News/2012/Smart-Specialisation/Context/>

¹² <http://s3platform.jrc.ec.europa.eu/>

occurred, meaning that it is difficult to obtain funding for applied type of projects that are not yet close to the market.

4.4.3 *Reflections by the panel*

On the issue of prioritisation, the Panel takes a dual perspective. First, the thematic perspective related to the question, 'should Iceland prioritise where it puts its money, and if yes, where?' Second, this perspective relates more to which reforms or policy interventions are needed first.

With respect to prioritisation in the first sense, a number of issues need to be cleared up. Prioritisation is not about exclusiveness, meaning that prioritisation should not imply that only 'option A' will be supported and nothing else. Prioritisation is first of all about the development of an overall vision on Iceland's growth model, on its industrial development and focus, and ultimately on its R&D areas needed to support this (comparable to the Iceland 2020 strategy¹³). Prioritisation is also about focusing on those areas that will support Iceland's long-term ambitions, and tackling major societal challenges. But let it be clear, it will also have to be the focus on areas where Iceland has assets and real potential, and where real economic value can be created.

The Panel also heard in many interviews that prioritisation is not currently undertaken at all. However, resources are allocated to RPOs, to programmes, and in competing funding every year based on the current (or past) prioritisation principles. There seems to be lack of knowledge about the current prioritisation principles. Again, the lack of transparency and openness in the system challenges the future options for further prioritisation and focus.

The Panel wishes to echo the recommendations made in the Taxell report. It is clear that Iceland needs to better prioritise and focus its efforts, while maintaining a basic and good level of horizontal support to so-called 'grass root initiatives' and the very important traditional sectors (like Fisheries). In this respect, it is not enough to start with a strong scientific base only, as there needs to be a critical reflect on the deployment potential of science, on the industrial base and the available ecosystem, and about the underlying value chain. The objective should be: socio-economic value creation. In times of budgetary restrictions and shortcomings, prioritisation is a sensible strategy.

R14. Immediate/short-term action: *The government and research funding organisations should explicitly explain their current prioritisation principles. This would establish the base line for more proactive prioritisation decisions. Suggested Lead: STI Policy Council*

R15. Immediate/short-term action: *The Icelandic government should further thematically prioritise its efforts and concentrate its resources in a smart way (and continue and even intensify the first movements in this direction). See also Taxell report 2009. Suggested Lead: STI Policy Council*

R16. Immediate/short-term action: *This prioritisation should not only be based on scientific excellence, but also on the potential for socio-economic value creation. A critical analysis (ex-ante impact assessment) of the current priorities should be carried out in order to evaluate the socio-economic potential of these areas. In this respect, industry should be intensively involved in this process. Suggested Lead: STI Policy Council*

R17. Immediate/short-term action: *Instrumental to R14 to R16, Iceland should take stock of the Smart Specialisation initiative (and available supporting material) of the European Commission - JRC in order to learn and understand how a*

¹³ Government of Iceland, "Iceland 2020 – governmental policy statement for the economy and community"; <http://eng.forsaetisraduneyti.is/iceland2020>

prioritisation process can work. Another good example is the prioritisation process that is on-going in the region of Flanders, which is strongly based on an intensive forward looking exercise (see: www.vrwiwiflanders2025.be). The specialisation process in Ireland can also work as an inspiring example. See <http://www.forfas.ie/publication/search.jsp?ft=/publications/2012/Title,9545,en.php> for Ireland's National Research Prioritisation Exercise. Suggested Lead: STI Policy Council

Ireland: selection criteria for the identification of priority areas

Drawing from the analytical data, potential candidate research priority areas had to fulfil each of the following criteria:

- a. The priority area is associated with a large global market or markets in which Irish-based enterprises already compete or can realistically compete.
- b. Publicly performed R&D in Ireland is required to exploit the priority area and will complement private sector research and innovation in Ireland.
- c. Ireland has built or is building (objectively measured) strengths in research disciplines relevant to the priority area.
- d. The priority area represents an appropriate approach to a recognised national challenge and/or a global challenge to which Ireland should respond.

Next to thematic prioritisation, there are other aspects that need to be prioritised. The institutional reforms (including a single institutional framework) need to be pushed forward. Cooperation, not competition, should be promoted internally. Iceland should turn to and focus on international competition. As also argued in the Taxell report, two universities (with regional dependencies), one overall PhD school, a joined secretariat and a well-developed technology transfer support system are good options for the reform of the academic system. The Panel has the impression that both the attention put on innovation, including services innovation, and deployment of knowledge are currently underdeveloped, although the Technology Development fund focuses on the funding of 'close to the market' projects.

In view of the size and limitation of the Icelandic system, internationalisation should be prioritised on all levels. Obtaining funding on the national level should be the basis for competing internationally (H2020, Nordic funds, etc.). According to the discussion participants, Iceland is falling behind in terms of infrastructure and equipment development. As such, tapping into international initiatives like ESFRI¹⁴, should be stimulated, next to dedicating available funds for 'catching-up'. This is indeed important. Maintaining or increasing levels of scientific and technological excellence requires access to top-infrastructure and facilities, either 'home' or 'abroad'. Increasingly, international researchers are drawn to the places where these facilities are located. Iceland should ensure a good level of infrastructure and facilities at 'home' but should also step into international initiatives and co-invest in infrastructure and facilities of the future that are far too expensive to invest in as a single country. The basis for priority investments in infrastructure should be in line with the earlier discussed strategic priorities.

¹⁴ http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri

As a result, the Panel puts forward the following recommendations:

- R18. **Mid-term action:** *Continue and even intensify the simplification process with respect to the university system. Implement the recommendations given in the Taxell report. Suggested Lead: STI Policy Council*
- R19. **Immediate/short term action:** *Focus on 'internal cooperation' and 'external competition'! Create the necessary platforms for internal cooperation, while stimulating international competition. Internationalisation should be on top of mind at every level. Suggested Lead: STI policy Council*
- R20. **Mid-term action:** *Adopt a national strategy (roadmap) on infrastructure and equipment and link it to a clear budget line; furthermore, tap into international initiatives (e.g. ESFRI) with respect to infrastructure and equipment development and seek to maximise national collaboration for new investments (joint-purchases) Suggested Lead: STI Policy Council*
- R21. **Mid-term action:** *The innovation policy mix (the mix of research and innovation support measures) has remained rather stable over time. In general the 'mix' always concentrated on research instead of innovation, on knowledge generation rather than on knowledge diffusion and application, on general/horizontal support instead of thematic focus/prioritisation, focusing on technological type of support as opposed to non-technological support (e.g. services, business model innovation, social innovation etc.), and finally focusing on direct as opposed to indirect types of support. In view of the previous recommendations, it should be considered whether this 'mix' is still adequate and effective. Suggested Lead: STI Policy Council*

4.5 Enhancing innovation through collaboration: bringing together companies and public research institutions

4.5.1 Introduction

Industry – science collaboration is important for a number of reasons, a major one being the insourcing of knowledge by industry in order to become and stay innovative, while providing financial and other support to research centers to continue their research. The collaboration can take different forms, ranging from contract research and hiring of graduates and co-supervising of PhDs, to technology transfer in the form of e.g. licensing.

In Iceland, industry – science collaboration needs more attention (cf. previous evaluations and reviews¹⁵). Iceland has a strong (to excellent) knowledge base in various disciplines but does not use the real 'value' from this knowledge to its full potential, according to the EIS indicators. Research infrastructure, industry – science mobility schemes, technology transfer facilities, incubators, and laboratories are essential in this respect. The current fragmentation of the system, universities operating independently from the research institutes (under the ministries), seems not to be conducive for effec-

¹⁵ E.g. OECD (2006). *Innovation Policy Mix Review - the case of Iceland*. OECD and The Ministry of Education, Science and Culture. Available at <http://www.oecd.org/dataoecd/15/62/36648108.pdf>; Taxell, C., Yelland, R., Gillespie, I., Linna, M., and Verbeek, A. (2009). *Education, Research and Innovation Policy. A New Direction for Iceland*. Reykjavik, The Ministry for Education, Science and Culture; European Commission, Annual appraisal reports Innovation Policy in Iceland, Trendchart/Erawatch.

tive industry – science collaboration. However, collaboration can obviously only be facilitated and not imposed.

4.5.2 Taking stock of the discussion

In general, Iceland has fallen 29 places since 2006 on the list of competitive levels of nations. Also with respect to the Innovation performance index, Iceland is the only nation in the OECD that did not improve from 2006 to 2013. In the universities, according to the participants, there is a strong focus on publications and less on patenting and the exploitation thereof. Although the Icelandic STI system is small, collaboration seems to be challenging here as well.

According to the participants, there is insufficient training of entrepreneurial skills in education and a lack of incentives for researchers in academia to proactively seek out industry collaboration. Moreover, the technology transfer mechanisms are not sufficiently developed and it appears to be difficult to filter the good ideas from the bad (and invest substantially in the former). Subsequently, once ideas are 'selected', there is insufficient capital available to make the difference. There is a need for more capital and the need to professionalise the IP management capabilities. Closer interaction with scientists is also required through a more active technology transfer platform and service. The attitude towards risk acceptance was discussed, an attitude where there is limited space and acceptance of failure. The lack of evidence on what the benefit is or might be for industry to collaborate more with academia, is apparently a factor that limits collaboration. Moreover, not all companies are ready to look for active collaboration with academia (there are only five companies that make a difference in terms of private R&D investment, Decode, Össur, Marel, CCP and Actavis). In this context, the tax incentive scheme for R&D active companies is an important instrument as it stimulates companies to become R&D active and as such to be better suitable for collaboration with academia.

4.5.3 Reflections by the panel

The panel is again heartened by the participants' level of self-reflection, who all seem to be well-aware of the both key problems and the potential solutions. But in taking these solutions forward it seems to be unclear as to whom should make the first move. Collaboration between the public and the private sector is essential, especially in countries such as Iceland, with a small and unstable system.

As it takes two to tango, industry should be made aware of, and incentivised where needed, to actively look for collaboration with the public sector; likewise in the public sector, where industry interaction should also be recognised as a societal obligation upon which universities and public research institutions should be evaluated.

The starting point for collaboration is information - information about which knowledge is available and where. There is a need, at least this is the impression of the Panel, to strongly professionalise the technology transfer services of both the universities and research institutions (see also above). IPR management and valorisation are full-time professional activities that need to be run as such. Finally, there is a role for public funding, and mainly competitive funding. More collaborative competitive funding will lead to more industry – science collaboration.

The Panel would like to make following recommendations:

- R22. Mid-term action:** *Professionalise and strengthen the technology transfer support activities, preferably one integrated support service for all universities and research centres (in line with R13). Suggested Lead: Universities and RPOs*
- a. *The centre should build up and share expertise on IPR protection and management (including the development of standard negotiation agreements with companies).*

- b. *The centre should lead the discussions on IPR ownership rules, in order to create clarity on the different options.*
- R23. **Mid-term action:** *There are plenty of good examples of how a professional technology transfer mechanism can be built up. Resources for this investment should be freed up through the earlier integration measures in the university system. Suggested Lead: Universities, the STI Policy Council*
- R24. **Mid-term action:** *Develop an information exchange platform or a brokerage platform, where knowledge providers can meet knowledge users. Suggested Lead: Universities, RPOs and Industry*
- R25. **Long-term action:** *Formalise the principle preparedness of both industry and academia (universities and research institutes) into a kind of 'innovation partnership', reflecting a long-term relationship with a specific objective, analogous to the EU innovation partnerships. Involve the government and look for different kinds of funding. The initiative can lie with industrial and academic actors, with no need to wait for government intervention. Suggested Lead: STI Council, involving Industry, Universities and Research institutes*
- R26. **Mid-term action:** *Universities and public research institutions should be made accountable for their industry outreach; concrete objectives and results should be taken-up in the management contracts. Suggested Lead: Ministry of Education, Science and Culture; Ministry of Industries and Innovation (as parent ministries)*
- R27. **Immediate/short term action:** *The government should increase funding for collaborative competitive funding (either through new funding or through re-orienting). Suggested Lead: STI Council*
- R28. **Mid-term action:** *Inside the universities and the relevant RPOs, a charter or a code could be developed on entrepreneurial and innovation policy, including principles on the evaluation of research staff, beyond the usual academic metrics, that actively interacts with industry/non-academia. Suggested Lead: Universities and RPOs*

4.6 Promoting and enabling the growth of companies

4.6.1 Introduction

Iceland has a strong entrepreneurial culture, a good general framework for entrepreneurs (ranking 7th of 36 OECD countries in 2012) and companies, and a high ranking on early adoption of new technology. The Technology Development Fund plays an important role as it has a more applied orientation and is thus directed to a larger degree at companies. As has been indicated in the self-assessment report, the success rate of the fund has been around 25% on average in the past five years. An impact assessment in 2010 showed that the large majority of the projects would not have been realised without the support of the fund, illustrating the lack of funding alternatives.

A lack of venture capital, especially during the growth phase of a company, is considered a major obstacle to the growth of companies in Iceland. Currently, there is only one large venture capital fund, NSA Ventures. In 2008, the government, banks and pension funds collaborated on the establishment of a closed fund – Frumtak. Frumtak aimed at investing in the more developed start-up companies. The operating period of the fund ended in 2013 and since then no new closed funds have emerged. There are ongoing attempts to establish a new closed fund in collaboration with the Icelandic pension funds.

An important obstacle for more inward venture capital are the capital controls, that often create a high level of complexity and bureaucratic obstacles in relations with investors, leading to reduced confidence in the Icelandic environment. The controls (now 6 years in place) have given investors a sense that they are a permanent feature of the system and hence cause more permanent investment risks. Foreign investors are thus putting increasing pressure on companies to move their headquarters out of Iceland.

Finally, in view of the limited internal market, growth of Icelandic companies should largely come from entrance into foreign markets. As discussed in the previous topics, it is the general impression that company support on aspects related to internationalisation (product-market intelligence, export, regulations etc.) is rather scarce.

4.6.2 Taking stock of the discussion

The discussion on the growth of Icelandic companies touched on various issues. One of these issues was overall growth focus and prioritisation, and the recognition of the importance of the knowledge economy to Iceland. The problem of 'implementation' was again raised as one of the most important factors for the lack of progress and change.

There has been a change in Icelandic industry's sectoral composition over time, e.g. the growth in the creative industries (government law allows repayment on film production in Iceland – around 1 billion ISK annually and this year it will be way beyond that). The interest of filmmakers to work in Iceland is constantly increasing. Tourism was also not part of the sectoral portfolio 20 years ago (in 2013 about 780,000 tourists visited Iceland), which creates possibilities but also challenges (e.g. in relation to infrastructure). In the meantime, clusters have become an important part of Iceland's policy. Notable examples are the maritime cluster, and there are on-going discussions to setup an aluminium cluster. Despite all this, there is general agreement that there is a lack of industry/sectoral oriented policy (see also the discussion on prioritisation).

Other important aspects in relation to growth are the small indigenous market, access to growth capital and entrepreneurial capabilities. The small Icelandic market size is clearly a problem for (local) growth. Funding and access to venture capital is also problematic. In relation to the Technology Development Fund, the fund grew considerably in 2013 after a period of relative stagnation since 2009. However, in order to achieve cut-backs in the national budget, the authorities reduced the fund again in 2014, nevertheless keeping it above the 2012 level. Next to this fund, Iceland has about 55 other funds where grants can be obtained. Next, there are the seed funds/micro seed funds (like the NSA ventures, Frumtak and Eyrir Investments, mainly large investments), and the business Angels (friends, families and fools). Apparently, for some of these investors, the Icelandic market becomes too small and many move abroad (USA and Europe mainly). In addition to the competitive funds there is also the tax incentive scheme (see also above) which is a good initiative. Nevertheless the refund ceiling is considered to be too low for many companies (max. of Mio ISK 20 ISK or EUR 125.000). Furthermore, there is a lack of evidence on the impact of the tax incentive scheme, which makes further negotiations (e.g. with the Ministry of Finance) on its reform difficult.

There seems to be a lack of knowledge and competence when it comes to entrepreneurship, internationalisation and marketing skills. Likewise, this also applies to knowledge on regulatory issues (like licenses and permits) where the official bodies in Iceland allegedly do not have/or only limited competence and know-how to give good advice to new companies.

4.6.3 Reflections by the panel

The Panel sees two large blocks of issues when it comes to how to stimulate the growth of companies in Iceland. The first one relates to funding, and the availability of investment funds. The second seems to be strategy and future vision, and the horizontal sup-

port and knowledge needed to make growth possible, growth that most likely has to take place outside Iceland (in view of its small market).

On the financial side, there is clearly a lack of local investment capital (or at least a problem related to freeing up capital to invest it in growing companies) and a large problem in attracting foreign capital as a result of the capital control restrictions (on which the Government is currently working). There are on-going discussions to mobilise pension funds and allow them to invest in/setup capital funds. Iceland could also consider 'crowd funding' type of capital raising, and generally make it attractive for private investors to invest in companies (as in Flanders, with the so-called 'win-win loans', where loans for young companies have been made taxation friendly). The tax reduction scheme also plays an important role in boosting R&D and ultimately creating innovations that allow companies to grow. During the discussions it became clear the tax scheme is a very important instrument that should be maintained, and where possible even expanded in terms of modalities and repayment ceilings. In order to move this along, it is essential to study and evaluate the socio-economic impact of the current tax scheme and predict the cost-benefits of further expansion. This seems wise, also in order to show the Ministry of Finance that the tax scheme is financially sound, and that its expansion will lead to a net benefit. Finally, when it comes to the Technology Development fund, attention should be paid not to allow for a too big gap with the Research Fund. Moreover, in view of the shown strong impact of the fund, a further strengthening certainly seems to be a good way forward, as this also means more competitive funding in the system.

- R29. Immediate/Short-term action:** *The Panel would like to use this opportunity to underline the negative impact of the capital control measures on Iceland's company portfolio. Major players are or will be forced to move outside Iceland as capital movements (in- or outflows) are limited. This will have strong economic and mainly employment effects. Suggested Lead: Ministry of Finance*
- R30. Immediate/short-term action:** *Make it possible for pension funds to prudently participate in investment funds. Suggested Lead: Ministry of Finance*
- R31. Immediate/Short-term action:** *Stimulate private investments and 'crowd funding' for companies by making it financially attractive (through tax breaks). Suggested Lead: Ministry of Finance*
- R32. Mid-term action:** *Maintain and even strengthen the tax incentive scheme for R&D, on the condition that an independent evaluation study shows positive impacts on economy and the society (cost-benefit analysis). Open a fact-based dialogue with the Ministry of Finance, and other Ministries when needed. Suggested Lead: STI Policy Council, Ministry of Finance*
- R33. Mid-term action:** *Strengthen the Technology Development Fund, while closing the 'gap' with the Research fund. Suggested Lead: STI Policy Council, Rannís*

On the second block of issues, it is again surprising to acknowledge the absence of a clear vision and strategy on the future growth model of Iceland (see also 'fundamentals'). During the discussions it became clear that new growth areas such as tourism are facing many challenges and that there is doubt about whether or not to support this sector, and to what extent. The Panel believes that there should be sufficient support to service sectors, like tourism, if this falls within the strategic vision of Iceland on how to grow. But there certainly needs to be a clear vision first on the future, and subsequently which sectors should be supported with public money. The cluster policies (the marine cluster was recently setup) that are currently being implemented are a good way forward. The Panel fully support the creation of new clusters (like the aluminium cluster) as long as they are based on scientific, technological and partly industrial strengths, in order for Iceland to make a real difference on the global scene. Of a slightly different note is the issue regarding how to help companies grow internationally, as the local market is (very) limited. It is clear that support services in this area need to be devel-

oped in order to help companies to enter new international markets. This support should include regulatory/legal aspects, such as how to obtain the necessary licences and permits, and even standards. Here again, the Panel sees potential synergies with other Nordic countries and the EU.

In short, the Panel recommends :

- R34. **Immediate/short-term action:** *In general, the Icelandic R&D policy mix should be sufficiently open to services. The tourism industry is apparently in need of this. This is currently an important growth sector and Iceland has to develop a vision on the future of this sector. Furthermore, many leading technological industries in the world are currently enhancing their potential by combining the services (such as maintenance, training of customers etc.) with products sold. Suggested Lead: STI Policy Council, Federation of Tourism/Iceland industries*
- R35. **Mid-term action:** *Focusing on 'new' growth sectors is certainly essential. But at the same time there needs to be sufficient attention to the 'old' sectors as these sectors often form the foundation of a nation. Iceland should be able to excel globally in sectors like fisheries, and set the benchmark for fisheries-related technology and innovation. Suggested Lead: STI policy Council*
- R36. **Mid-term action:** *Cluster policies are indeed the way forward. The Panel welcomes the creation of new clusters. At the same time, clusters should be based on a strong knowledge and industry base, or at least be 'plugged into' a strong knowledge and industry base (value chain perspective). Suggested Lead: STI Policy Council and the Ministry of Industries and Innovation.*
- R37. **Immediate/short-term action:** *Expertise needs to be built up with respect to support of companies in internationalisation, particularly the regulatory/legal aspects hereof. Companies need to be supported in dealing with licenses and permits, standards and IPR. Where possible, synergies need to be developed with other Nordic or EU countries. Suggested Lead: Ministry of Industries.*

4.7 Educating for innovation: developing skills for a knowledge-driven society

4.7.1 Introduction

The last topic discussed in this peer review was the role of education in developing the necessary skills for society, including innovation. In Iceland, there are seven higher education institutions that operate under two different legal acts. Four of them are public institutions, two non-profit organisations and one is a limited liability company. Universities have high academic autonomy, but low autonomy in organisational, financial and staffing issues¹⁶. The public expenditure on tertiary education, including subsidies to households, which in the case of Iceland refers to the Icelandic Student Loan Fund, is slightly above the OECD average in 2010, but considerably lower than in the other Nordic countries. The total expenditures are lower than the OECD average, because the private expenditures are very low. In this sense, Iceland differs from the other countries where private expenditures are low (countries that do not have a tradition of tuition fees), but where public expenditures tend to compensate for the lack of private financing.

¹⁶ European University Association, 2011.

The self-assessment report furthermore indicates that Iceland is below the EU average in tertiary education graduates in the natural science and technology and that a better connection between the educational system and the needs of the industry is required. Primary education also needs to be improved in order to cultivate creativity, technological skill and critical thinking. Although the public expenditure on pre-primary and primary educational institutions as a percentage of GDP is comparatively high, the results are below expectation. Iceland has been losing ground in young people's skill in reading, mathematics and the natural sciences according to the OECD PISA survey, and is now lower than the OECD average.

Icelandic universities only recently began to provide doctoral education. Until then, most Icelanders went abroad to take a PhD. Currently, three higher education institutions are accredited to award such degrees: the University of Iceland, the Agricultural University (in collaboration with the University of Iceland) and the University of Reykjavík. In the years 2000-2003 there were, on average, 6 doctoral graduates per year from the largest university, the University of Iceland, but in the past four years (2010-2013) this number has increased to 44 PhDs per year on average. The working conditions for PhDs and post-doc lecturers are under significant pressure and the career prospects for young researcher are not positive. The University of Iceland has seen a strong growth of PhD researchers from abroad, most likely due to the 'no fee policy'. Work permit regulations make it difficult for researchers outside the EEA to come to Iceland.

Two sessions took place in relation to this topic. One of these sessions, was a discussion with a group of PhD students and post-doctoral researchers. The results are presented below.

4.7.2 Taking stock of the discussion

Young researchers benefit from the high level of excellence in many research areas in Iceland but the environment for PhD students and post-doctoral researchers is still underdeveloped.

The first issue discussed was the teaching of innovation and other types of transferable skills, which generally receive far too little attention. There was consensus on the fact that the education system has a responsibility to create manpower (correct disciplines, needed capabilities, real-world relevance), train innovators (students and faculty) and support innovation (hub for activity/support), but low university funding and the negative investment environment currently makes this difficult, if not impossible.

The 'disconnect' between industry and academia leads to a bad fit between demand and the supply in terms of skills and expertise, but also in the number of graduates in e.g. science and engineering. Industrial PhD programs do not exist currently in Iceland. The participants again refer to the lack of an overall future vision (e.g. with respect to the PhD programs) needed to guide the choices (prioritisation) and associated actions.

The underfunding of the system is highlighted as a major problem, next to the organisation and structure of the education system. The way that funding is distributed is also seen as problematic in the sense that high levels of institutional funding make adaptation in terms of behaviour and flexibility difficult, opposed to a more competitive way of allocating funds.

In the last section of the programme, a discussion took place with a group of PhD students and early stage post-doctoral researchers. The quality of research and the presence of top researchers (star researchers) were considered as attractive environmental factors. But challenges and problems were also raised. More than once, reference was made to the fragmentation of the system and the lack of funds (especially since the cutbacks as a result of the economic crisis). Scholarships or grants are difficult to obtain and the numbers available are rather low. Most of the researchers have to find an additional job, which has implications for the duration of their PhD (often about 6-7 years).

The teaching load is high as a result of the high inflow of students during the economic crisis.

The afore-mentioned lack of funding has serious implications for the working conditions, which are generally considered to be poor. It is felt that the attention put on transferable skills should be increased, and that there should be more interaction with industry (or non-academia). The prospects after undertaking a PhD or a post-doc are not positive. There is hardly any guidance on how to valorise the PhD outside academia. A true academic career is only available for a few, as there are very few positions available. Employment outside academia is hard to find because of a lack of a need for PhD graduates (depending obviously on the discipline and the sector involved). Access to infrastructure and equipment was also raised as being problematic.

4.7.3 Reflections by the panel

Different indicators about the scientific success of Icelandic universities reveal strong performances in various disciplines. Excellence has been increasing strongly in particular areas over time. Consideration should be given to the question as to whether this focus on scientific output and visibility affects the training and support given to future researchers. It is essential that good working conditions are available to researchers and that structured training is provided in order for them to develop transferable skills. An excellent initiative on which to base future strategy in this area is the EU initiative on Innovative Doctoral Training Principles¹⁷, which provides clear recommendations on how to set up a good PhD training program.

The Panel is fully aware of the substantial budget cuts that have hit the research environment, especially for young researchers. This does not seem sustainable. However, the enthusiasm and positive attitude of the researchers the Panel met was obvious. What came as a surprise to the Panel is that Iceland has different PhD programs and not one strong and integrated program. The Taxell report made clear recommendations in this respect, and the Panel would like to re-emphasise these in order to free up funds and to reduce fragmentation.

The academic system in Iceland, including the research institutions, is too introverted and is insufficiently aware of the benefits that collaboration with industry might have, not least for the researchers that are training and delivering. There is significant responsibility towards helping these young researchers who obtain a PhD in order to ensure that they have the right skills for a future job, either inside or outside academia. Industry, or non-academic interaction, is crucial in this respect. This obviously can take many forms, including involving industry in PhD advisory committees, or designing an industry PhD program, or by intensifying contract research, or even by opening up industry sponsored chairs. The right incentives have to be put at the right place to make this happen. Both industry and academia, and the individual researchers and their teams, should benefit.

In light of the above, the Panel makes the following recommendations.

R38. Immediate/short-term action: *The Taxell report provides a series of recommendations on how to reduce fragmentation and create synergies in the education system. The Panel believes that these recommendations are still applicable and thus they should be operationalised further and implemented. Suggested Lead: Ministry of Education, Science and Culture*

R39. Mid-term action: *PhD training in Iceland should be evaluated against the broadly accepted and embraced principles for Innovative Doctoral Training. On the basis of the outcome, the PhD training programs should reformed and sub-*

¹⁷ http://ec.europa.eu/euraxess/pdf/research_policies/Principles_for_Innovative_Doctoral_Training.pdf and http://ec.europa.eu/euraxess/pdf/research_policies/IDT%20Final%20Report%20FINAL.pdf

stantially more attention should be paid to transferable skills and structured training (on innovation skills, business plan development etc.), to better working conditions, to industry interaction etc. Suggested Lead: Ministry of Education, Science and Culture

- R40. **Immediate/short-term action:** *Specifically on industry interaction, the introduction of an industry PhD should be designed and established in close consultation with industry. There are several interesting practices that could be considered, such as the Danish or Flemish models¹⁸ (Baekeland Mandaten managed by the Flemish IWT). Suggested Lead: Ministry of Education, Science and Culture*
- R41. **Mid-term action:** *Moreover, incentives should be built in for researchers to actively reach out to industry, such as the formal evaluation and valuation of these activities in the overall evaluation of academic staff. Suggested Lead: Universities*
- R42. **Immediate/short-term action:** *Finally, it certainly seems to the Panel that more money is needed in order to continue the 'stairway to excellence' and to provide an attractive perspective for tomorrow's researchers. This funding should be competitive in nature, and could/should be linked to programs and not institutions. This gives the necessary flexibility to shift funds around, based on potentially changing priorities. Suggested Lead: STI Policy Council*

¹⁸ <http://www.iwt.be/english/welcome>

Annex 1 – Agenda ERAC peer review meeting in Reykjavik, Iceland

MENNTA- OG MENNINGARMÁLARÁÐUNEYTIÐ



Agenda for ERAC peer-review meeting in Iceland 2-4 April 2014

Ministry of Education, Science and Culture

Sölvhólgötu 4, 101 Reykjavík

Meeting room 4th floor

Peers: Francien Heijs, John Dooley and Riitta Maijala

European Commission: Diana Senczyszyn

Independent expert: Arnold Verbeek

Ministry of Education, Science and Culture: Ásdís Jónsdóttir

Rannís: Þorsteinn Gunnarsson and Eva Diego Þorkeldsdóttir

Wednesday April 2nd

- 19:00 – 19:10 Welcome
Ásta Magnúsdóttir, Permanent Secretary, Ministry of Education, Science and Culture
- 19:10 – 19:40 Science and Innovation in Iceland: an Introduction
Guðrún Nordal, Director, Árni Magnússon Institute and chair of the Science Committee
- 19:40 Reception

Thursday April 3rd

- 9:00-11:00 Session 1 From planning to action: challenges in the governance of science and innovation
- 9:00-9:10 Welcome
- 9:10-9:40 Presentations
- 9:40-11:00 Discussion
Participants:
- | | |
|----------------------|---|
| Álfrún Tryggvadóttir | Head of Division, Ministry of Finance and Economic Affairs |
| Davíð Lúðvíksson | Director of Sectorgroups, service and development, Federation of Icelandic Industries |

	Eiríkur Steingrímsson Guðrún Nordal	Professor in Health Sciences, University of Iceland Chair of the Science Committee and director, Árni Magnússon Institute for Icelandic Studies	Pres.
	Hallgrímur Jónasson Haukur Alfreðsson Hellen Gunnarsdóttir Héðinn Unnsteinsson	General Director, Icelandic Centre for Research (Rannís) Director, High Technology and Seed Companies Forum Director, Ministry of Education, Science and Culture Policy Analyst, Prime Minister's Office	Pres.
	Magnús Lyngdal Magnússon Sveinn Margeirsson Una Strand Viðarsdóttir	Office Director, Graduate School, University of Iceland Chair of the Technology Committee and CEO, Matís Adviser, Ministry of Education, Science and Culture	Pres.
11:00-11:30	Coffee		
11:30-13:30	Session 2 Intelligent prioritization: governing a small country in a globalized world <i>Lunch will be served during the session</i>		
11:30-11:40	Welcome		
11:40-12:00	Presentations		
12:00-13:30	Discussion Participants:		
	Guðrún Nordal	Chair of the Science Committee and director, Árni Magnússon Institute for Icelandic Studies	
	Guðrún A. Sævarsdóttir	Head of Department, Technology and Engineering, Reykjavík University	
	Hallgrímur Jónasson Hellen Gunnarsdóttir Jón Atli Benediktsson	General Director, Icelandic Centre for Research (Rannís) Director, Ministry of Education, Science and Culture Pro-Rector of Academic Affairs and Professor, Faculty of Electrical and Computer Engineering, University of Iceland	Pres.
	Jón Ólafsson Magnús Karl Magnússon Una Strand Viðarsdóttir	Professor, Bifröst University Professor, Faculty of Medicine, University of Iceland Adviser, Ministry of Education, Science and Culture	Pres.
13:30-14:30	Debriefing and a walk to Harpa, concert house		
14:30-16:30	Session 3 Enhancing innovation through collaboration: bringing together companies and public institutions		
14:30-14:40	Welcome		
14:40-15:00	Presentations		
15:00-16:30	Discussion Participants:		
	Gunnar Valur Sveinsson Halldór Jónsson Haukur Alfreðsson Hekla Arnardóttir Héðinn Unnsteinsson Hrafnkell Eiríksson Kári Stefánsson Kristján Kristjánsson Ólöf Vigdís Ragnarsdóttir	Project Manager, Icelandic Tourist Industry Association Director of Research Affairs, University of Iceland Director, High Technology and Seed Companies Forum Investment Manager, NSA Ventures Policy Analyst, Prime Minister's Office Engineer, Marell CEO, deCODE Genetics Director of Research Services, Reykjavík University Lawyer, Division of Science and Research, University of Iceland	Pres.
	Sveinn Margeirsson Þorsteinn Sigurðsson	Chair of the Technology Committee and CEO, Matís Head of Marine Resources Section, Marine Research Institute	Pres.
16:30-17:30	Debriefing of peers		

19:00 Dinner at Sjávargrillið, Skólavörðustíg 14

Friday April 4th

9:00-10:00 Debriefing of peers

10:00-12:00 Session 4 Promoting and enabling the growth of companies

10:00-10:10 Welcome

10:10-10:40 Presentations

10:40-12:00 Discussion

Participants:

Árni Þór Árnason	CEO, Oxymap	
Berglind Hallgrímsdóttir	Managing Director, Innovation Center Iceland	Pres.
Bryndís Skúladóttir	Environment and Energy, Federation of Icelandic Industries	
Davíð Lúðvíksson	Director of Sectorgroups, service and development, Federation of Icelandic Industries	
Ingvar Hjálmarsson	Director of Marketing and Business Development, Nox Medical	
Kristján Freyr Kristjánsson	VP Icelandic Business, Meniga	Pres.
Magnús Oddsson	Director of R&D Prosthetics, Össur	
Róbert Farestveit	Economist, Icelandic Confederation of Labour	
Sveinn Þorgrímsson	Director General, Ministry of Industries and Innovation	

12:00-13:00 Lunch

13:00-15:00 Session 5 Educating for innovation: developing skills for a knowledge-driven society

13:00-13:10 Welcome

13:10-13:40 Presentations

13:40-15:00 Discussion

Participants:

Ari Kristinn Jónsson	Rector, Reykjavík University	Pres.
Berglind Rós Guðmundsdóttir	Software Personel Manager, CCP Games	
Björg Pétursdóttir	Head of Division, Ministry of Education, Science and Culture	
Frosti Gíslason	Project Manager, Innovation Center Iceland	
Halldór Árnason	Economist, Confederation of Icelandic Employers	
Hekla Arnardóttir	Investment Manager, NSA Ventures	
Katrín Dóra Þorsteinsdóttir	High Tech and Education, Federation of Icelandic Industries	
Kristján Kristjánsson	Director of Research Services, Reykjavík University	
Rögnvaldur Sæmundsson	Project Manager, University of Iceland	Pres.
Sigurjón Mýrdal	Head of Division, Ministry of Education, Science and Culture	
Steinunn Gestsdóttir	Senior Lecturer, Faculty of Psychology, University of Iceland and Vice Chair of Science Committee	
Tatjana Latinovic	Intellectual Property Director, Össur and Vice Chair of Technology Committee	
Þorvaldur Ingvarsson	VP of R&D, Össur	

15:00-15:20 Coffee

15:20-16:20 Meeting with young researchers

15:20-15:30 Welcome

15:30-16:20 Discussion

Participants:

Erla Hlín Hjálmarsdóttir

PhD candidate, School of Social Sciences, University of Iceland

Erna Magnúsdóttir

Research associate, School of Health Sciences, University of Iceland

Linda Bára Lýðsdóttir

PhD candidate, School of Health Sciences, University of Iceland

Marías Halldór Gestsson

Adjunct lecturer, Institute of Economic Studies, University of Iceland

Sigríður Rut Franzdóttir

Research Associate and Adjunct Lecturer, School of Engineering and

Natural Sciences, University of Iceland

Stanislav Ogurtsov

Post-doc, Electrical Engineering, Reykjavík University

Þórey Ólöf Gylfadóttir

PhD candidate, Agricultural University of Iceland

16:20-18:00 Debriefing of peers

Annex 2 – Self-assessment Report Iceland

The self-assessment report is available as a separate report.

Annex 3 – Data compendium

The data compendium is available as a separate report.