Linking Russia to the ERA: Coordination of MS’/AC’ S&T programmes towards and with Russia

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<td>The ERA.Net RUS foresight exercise has prepared structural and thematic scenarios for Research, Development and Innovation (RDI) cooperation between EU Member States (MS), Associated Countries (AC) to FP7 and Russia. The term structural scenario refers to institutional solutions and instruments (e.g. funding programmes) for the cooperation, whereas the term thematic scenario refers to relevant thematic priorities for the cooperation. The elements and results of this comprehensive foresight, which was implemented in the period 2010-2014 are presented in this report.</td>
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0. Abbreviations

AC  Associated countries: Non-EU countries, who have agreed, negotiated and paid to participate in the Framework Programme.
AKA  Academy of Finland
BMWF  Austrian Federal Ministry of Science and Research
BMWFJ  Austrian Federal Ministry of Economy, Family and Youth
BRICS  A grouping acronym that refers to the countries of Brazil, Russia, India and China
CIS  Commonwealth of Independent States
CNRS  National Centre for Scientific Research, France
COST  European Cooperation in Science and Technology
DFG  German Research Foundation
EC  European Commission
ENV  Environment
ERA  European Research Area
EU  European Union
EURATOM  The European Atomic Energy Community
FASIE  Foundation for Assistance to Small Innovative Enterprises
FFG  Austrian Research Promotion Agency
FP  The EU Framework Programme for Research and Technological Development
FSU  Former Soviet Union
FTP  Federal Targeted Programme (Russia)
GPF  Group of Funding Parties
HSE  State University – Higher School of Economics
IB-DLR  International Bureau of the Federal Ministry of Education and Research (BMBF), Germany
ICISTE  International Centre for innovation in Science, Technology and Education
ICPC  International cooperation Partner Countries
ICT  Information and Communication Technology
INTAS  International Association for the promotion of cooperation with scientists from the New Independent States of the former Soviet Union
IPR  Intellectual Property Rights
IPTS  European Commission -Joint Research Centre - Institute for Prospective Technological Studies
IST  Information society technologies
ISTC  International Science & Technology Center
KBBE  Knowledge Based Bio Economy
MS  Member States
NIS  National Innovation System
NMP  Nanotechnology, Materials and New Processes
R&D  Research & Development
RAS  Russian Academy of Sciences
RCN  The Research Council of Norway
RDI  Research Development & Innovation
<table>
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<th>Acronym</th>
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<tr>
<td>RFBR</td>
<td>Russian Foundation for Basic Research</td>
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<td>RFH</td>
<td>Russian Foundation for Humanities</td>
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<tr>
<td>RTD</td>
<td>Research and Technological Development</td>
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<tr>
<td>RTDI</td>
<td>Research, Technological Development and Innovation</td>
</tr>
<tr>
<td>RUS</td>
<td>Russia</td>
</tr>
<tr>
<td>S&amp;T</td>
<td>Science and Technology</td>
</tr>
<tr>
<td>SAC</td>
<td>Scientific Advisory Committee</td>
</tr>
<tr>
<td>SFIC</td>
<td>EU Strategic Forum on International S&amp;T Cooperation</td>
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<tr>
<td>SME</td>
<td>Small and medium-sized enterprises</td>
</tr>
<tr>
<td>SSH</td>
<td>Social Sciences and Humanities</td>
</tr>
<tr>
<td>STI</td>
<td>Science, Technology &amp; Innovation</td>
</tr>
<tr>
<td>SWOT</td>
<td>Analysis of Strengths, Weaknesses, Opportunities and Threats</td>
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<tr>
<td>TEKES</td>
<td>Finnish Funding Agency for Technology and Innovation</td>
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<td>TNP</td>
<td>Transport</td>
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<tr>
<td>TÜBITAK</td>
<td>The Scientific and Technological Research Council of Turkey</td>
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<tr>
<td>UB RAS</td>
<td>Ural Branch of the Russian Academy of Sciences</td>
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<tr>
<td>WTO</td>
<td>World Trade Organization</td>
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<td>ZSI</td>
<td>Centre for Social Innovation</td>
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1 Introduction

A foresight exercise has been one of the central elements of the EU FP7 funded ERA.Net RUS project. The foresight exercise has prepared structural and thematic scenarios for Research, Development and Innovation (RDI) cooperation between EU Member States (MS), Associated Countries (AC) to FP7 and Russia. The term structural scenario refers to institutional solutions and instruments (e.g. funding programmes) for the cooperation, whereas the term thematic scenario refers to relevant thematic priorities for the cooperation. The foresight and the resulting scenarios have provided a basis for suggesting measures for improving the RDI cooperation and for developing a sustainable joint funding programme between EU MS/AC and Russia. These measures and possible programme have been outlined and published in an ERA.Net RUS Vision Paper and an Action Plan for implementation.

Analytical support for the funding activities within ERA.Net RUS and an upcoming ERA.Net RUS Plus has proved useful and provided valuable input for the project. For example, discussions on the ERA.Net RUS Pilot Joint Call have shown that issues such as the definition of the thematic scope of the call are highly relevant for Programme Owners, which cannot quickly be solved. Thematic roadmapping workshops provided a structured process in the frame of the foresight to facilitate the definition of topics.

The foresight exercise was kicked off with a methodological and planning workshop in September 2010. As a second step, a Joint ERA.Net RUS Creativity and IPTS Foresight Workshop was held in Seville/Spain. It gave room to discuss the critical variables and define the dimensions of scenarios for sustainable mid-term cooperation in S&T and innovation between the EU MS/AC and Russia. Four different scenarios were then elaborated in detail and validated in a workshop in November 2011 with the ERA.Net RUS Group of Funding Parties. In February/March 2012, the scenarios and its framework conditions and critical variables were being assessed in a broad Delphi survey among researchers, policy-makers and other experts involved in EU MS/AC–Russia R&D and innovation cooperation. A second survey round based on the results of the first Delphi round and focused on thematic areas for research and innovation cooperation was implemented in February 2013. The survey results were integrated in this report and in the measures proposed for enhancing EU-Russia RDI cooperation. Finally this foresight report was presented at an ERA.Net RUS conference on perspectives for future cooperation, which took place in Istanbul in July 2013.

The results of the foresight were disseminated broadly, at various conferences (e.g. in Bonn at a conference on S&T cooperation with Eastern European and Central Asian Countries), scientific publications (e.g. at the European Foresight Platform), and towards relevant policy makers: e.g. towards the European Commission, the EU Strategic Forum on International S&T Cooperation (SFIC).

This report is structured in 8 chapters and an annex. We first outline the process of foresight implementation and the methods used. This is followed by an overview of multilateral and bilateral RDI cooperation between the EU MS/AC and Russia, and the institutional solutions found for this cooperation instruments. We highlight then in chapter 4 the environment for

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1 EU member states are: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom

2 Countries associated to the FP7 are: Albania, Bosnia and Herzegovina, Croatia, Faroe Islands, FYR of Macedonia, Iceland, Israel, Liechtenstein, Moldova, Montenegro, Norway, Serbia, Switzerland, Turkey
EU-Russia RDI cooperation, such as the state of the Russian National Innovation System and framework conditions for the cooperation. In chapters 5 and 6 we show the results of the structural and thematic foresight activities. On this basis, recommendations and concrete measures are proposed for enhancing EU-Russia cooperation in RDI. In particular a cooperation according to Article 185 Treaty on the Functioning of the European Union (TFEU) is proposed as a possible follow-up cooperation programme to the ERA.Net RUS Plus. In the final chapter conclusions on the foresight results and the cooperation perspectives will be outlined. An annex to the report compiles detailed analysis having emerged from the foresight.
2 Methodology

A great variety of methodologies was used within the ERA.Net RUS project. These include:

1. Desk research and analysis for a background study on EU MS/AC–Russia cooperation in research and innovation.
2. A SWOT analysis of EU MS/AC – Russia cooperation on R&D and innovation.
3. A Scenario Development to discuss potential future states of EU-Russia collaboration.
4. A Delphi survey in two rounds
5. A meta-analysis of foresight studies and expert survey to identify the main thematic areas of EU-Russia collaboration.
7. Roadmapping elements.

In this section we will explain these different tools in detail.

2.1 Desk research and analysis

Desk research and analysis were performed for preparing a background study on EU MS/AC and Russia cooperation on research and innovation. This study was used on several instances in the research process. It was used as a background and input document for foresight workshops and was also integrated in an updated form in this foresight report.

2.2 SWOT analysis

An analysis of Strengths and Weaknesses, of Opportunities and Threats (SWOT) of EU MS/AC and Russia cooperation in R&D and innovation was performed at the outset of the foresight process, in the frame of a creativity workshop (Seville 2010). Results are presented in chapter 5.

2.3 Scenario development

A scenario is a “story” illustrating visions of possible future or aspects of possible future. It is perhaps the most emblematic foresight method.\(^3\) In the framework of the ERA.Net RUS project, scenarios were developed to explore sustainable mid-term cooperation in S&T and innovation between the EU MS/AC and Russia.

In order to develop the scenarios the ERA.Net RUS consortium proceeded in the following steps:

\(^3\) There are many different possible ways of developing scenarios, the interested reader is referred to the EFP website for more details (http://www.foresight-platform.eu/community/foresightguide/practicing-foresight-taking-stock-and-advancing-knowledge/how/methodology/main-methods/meth_scenario/).
1. A creativity workshop, held in Seville in December 2010. The workshop identified the key dimensions around which the scenarios should be developed and drafted several snapshots (i.e. short, schematic descriptions) of such scenarios.

2. The development of four of the above-mentioned snapshots into complete scenarios.

3. A validation workshop, held in Paris in November 2011, with experts on EU–Russia Cooperation, which provided feedback to finalize the scenarios.

For each workshop the ERA.Net RUS team prepared a background document to ensure the audience was properly prepared.

The creativity workshop

The two–day creativity workshop started with a series of both theoretical and practical presentations on the scenario methodology, foresight studies, and S&T collaborations. These allowed preparing participants from different backgrounds to take part in the exercise, especially those without any foresight experience.

Following those, four groups moderated by IPTS and ZSI staff members carried out an interactive SWOT analysis on the EU–Russia S&T relationship. This served as a starting point to discuss in five small groups the alternative views on future R&D and innovation cooperation between the EU and Russia. Specifically, the groups were discussed, and then presented, the discriminating factors (drivers and shapers) for the alternative future snapshots.

The second day started with a plenary discussion to identify the key dimensions across which the scenarios should be developed. The main axes consisted of:

- **S&T policy integration vs. disintegration**
- **low vs. high R&D investment**

The secondary axes consisted of:

- **private vs. public investment**
- **high vs. low performance**

This resulted in the overview below:

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4 The creativity workshop was held together with a Foresight Training event. The whole methodological process was taught to a wide audience.
Following that, the small groups proceeded to position their snapshots in the grid and discussed their potential evolution from the current day (2010) to 2020. At the end of the workshop, the different snapshots were presented in the plenary session and four of them were selected for further elaboration and validation. In chapter 5 the results of this are presented in further detail.

The creativity workshop was attended by nearly 40 participants, comprising foresight practitioners, scholars and policy makers, both from EU countries, accession countries and Russia.

**Drafting the scenarios**
Following the workshop, the ERA.Net RUS consortium proceeded to develop the following four snapshots into complete scenarios:

1. R&D policy paradise
2. Empty cooperation shell
3. Isolated R&D excellence
4. More of the same (bilateral cooperation)

Each scenario consisted of the following elements:
- A storyline describing in detail the situation in 2020.
- The identification of the main drivers of change that led to such situation.
- The identification of the main impact variables
- A schematic roadmap describing the evolution of the situation from 2010 to 2020.

Brief descriptions of each scenario were developed (and used, among the others, for the DELPHI survey) and are presented in chapter 5.
The validation workshop
The validation workshop was held in Paris in November 2011 and comprised EU and Russian experts in scientific collaboration.

The audience was divided in two groups, which evaluated how realistic and/or desirable each scenario was. Furthermore, the groups discussed in detail the strengths and weaknesses of each individual scenario and identified the critical issues that any EU-Russia cooperation scenario should deal with, namely: qualified human resources, regulatory framework, research infrastructure, economic development. The whole process allowed the consortium to identify the most likely and most attractive scenario and started the reflection on how to avoid falling into the path of least resistance and move towards a more desirable future.

The validation workshop was attended by about 20 participants. Representatives of funding agencies and funding partners of the ERA.Net RUS consortium, as well as from ministries from EU MS/AC and from Russia were present.

2.4 The Delphi survey
The outcomes of the validation workshop were critical in shaping the Delphi questionnaire. This was organised in two rounds: the aim of the first round was to dig further in the likelihood and desirability of each scenario. The aim of the second round was to identify and assess the measures to reach the most desirable situation, as well as to identify areas for thematic S&T cooperation.

Specifically Delphi-round I assessed:
1. Likelihood of EU-Russia RDI cooperation scenarios validated in step 2.
2. The likely of several background Conditions for EU-Russia RDI cooperation.
3. A general assessment of EU-Russia RDI cooperation perspectives.

On the other hand Delphi-round II assessed:
1. The interest from researchers in the EU MS/AC and Russia in specific thematic fields of cooperation.
2. The interest in specific cooperation instruments.

The Delphi survey was addressed to:
- all European funding organisations, cooperating with Russia
- co-publishing researchers from EU MS/AC and from Russia (for the reference year 2010)
- Russian researchers from a database of HSE
- a list of multi- and bilaterally cooperating researchers
- experts engaged in international cooperation
- ERA.Net RUS consortium partners
- applicants to the ERA.Net RUS pilot joint calls
- representatives of the European Commission
- R&D and innovation policy makers in the EU MS/AC and Russia
The overall sample of experts was mainly the same in both rounds. By far the largest group in the sample were co-publishing researchers (approximately 4000 experts). The survey questionnaire was developed both in Russian and English languages. The number of experts invited to fill in the English questionnaire was around 4600, the number of experts invited to fill in the Russian questionnaire was around 2400. The overall response rate was of around 23% for round I and of around 15% for round II. The main results of the Delphi rounds are presented in chapter 5 (structural elements) and 6 (thematic elements); a detailed analysis is available in the annex to this report.

2.5 Identification of thematic priorities through a meta-analysis and an expert survey

To identify key thematic priorities for EU–Russia cooperation, the ERA.Net RUS consortium not only used the results of the second round of the Delphi questionnaire, but also conducted a meta-analysis of foresight exercises and policy documents as well as a series of interviews with thematic experts (i.e. the expert survey).

The review analysed priorities at the EU level, priorities for selected EU countries and priorities for Russia. Secondly it compared them to see similarities, differences and overlaps. Following this meta-analysis the following areas were selected for deeper investigation through an expert-survey.

- Environment and climate change
- Food and Agriculture
- Transport
- Energy (including Nuclear fission)
- Health
- Nanotechnology and New Materials

For each of these areas the ERA–Net RUS consortium interviewed at least 1 expert operating in the EU, and 1 operating in Russia. To be selected the experts had to meet two criteria:

1. A proven record of expertise in a given area
2. Experience with international cooperation and in particular with EU-Russian cooperation

The experts were interviewed by phone (in some instances they preferred to give their answers by email) and were asked a series of questions about (1) their day-to-day work and experience with the EU/Russia and (2) their opinion on the future of cooperation EU/Russia cooperation in their given field. The interview lasted on average 20 minutes and the outcome of the survey fed into the second round of the Delphi (described in the previous section).
2.6 Dissemination on methodology and outcomes of the ERA.Net RUS foresight dimension

In the course of the implementation of the foresight dimension of the ERA.Net RUS project, several initiatives have been taken to share and refine methodologies with the wider foresight community as well as interim results. Examples of dissemination include:

- presentation of a poster\(^5\) at the 2011 Seville Conference on Future-Oriented Technology Analysis (12 – 13 May 2011)
- publication of a policy brief\(^6\) in the context of the same conference
- publication of a policy brief at the European Foresight Platform, June 2011\(^7\)
- an article in Baltic Rim Economies\(^8\), December 2011
- publication of a foresight background paper,\(^9\) 2013

Further dissemination initiatives will be undertaken, both with regard to methodology as well as with regard to content and outcomes of the foresight work. A non-exhaustive list of initiatives includes the following:

- A draft paper has been accepted for presentation at the International Foresight Academy – Seminar 16.-19.Sept. 2013 - ZHAW (Winterthur)
- This foresight report will be published as a JRC publication in the course of Autumn 2013, to be distributed at key events (e.g. the kick-off meeting of the ERA.Net RUS Plus, events in the context of the 2014 EU-Russia Year of Science, etc.).


3 Foresight Background

3.1 Russia’s multilateral RDI cooperation with the EU MS/AC

Russia has put an important focus on RDI cooperation with the EU. This policy focus was acknowledged in 2008 by the European side in the Commission Communication on international S&T cooperation, where it is stated that Russia “has made it clear that it sees the EU as its long-term priority in S&T cooperation”.

The cooperation is backed up by a comprehensive framework of formal agreements and arrangements between Russia and the EU, which has been put in place over the years. The EU and Russia have concluded a Science and Technology agreement in 1999, which was renewed in 2003 and 2009 for five year periods respectively. It underpins legally the participation of Russian scientists in the EU’s Framework Programme for Research and Technological Development (FP) and the cooperation in other European initiatives such as COST and EUREKA. Since 2001 S&T agreements are also in place for EURATOM, covering nuclear fission as well as fusion. Under the S&T agreement a forum for an S&T policy dialogue has been established with the joint EU-Russia S&T Cooperation Committee. Another forum for S&T policy dialogue at the ministerial level, is the Permanent Partnership Council on research between the EU and Russia, which held its first meeting in May 2008.

An operational framework for intensifying cooperation was agreed in 2003 between the EU and Russia with the “four common spaces”, which comprise a common space of research and education, including cultural aspects. For the implementation of these spaces, roadmaps have been established since 2005. In the case of research, envisaged measures are, among others, identifying thematic priorities for cooperation, facilitating the participation of Russian teams in the FP, and enhancing of mobility of researchers. The current EU-Russia roadmap on scientific and technological cooperation for the years 2011-2013 covers thematic fields and sub-programmes of the FP, including the European Research Council. The measures foreseen shall facilitate Russia’s full integration into the European Research Area (ERA).

The S&T agreement and the common spaces shall be taken up in a new framework agreement on cooperation between the EU and Russia. Negotiations on this agreement were launched in June 2008 at the EU-Russia summit in Khanty-Mansiysk in Russia, but are advancing only slowly and no agreement could yet be concluded.

A recent joint EU-Russia initiative is a “modernisation partnership”, which was agreed in spring 2010 between European Commission President Barroso and then Russian President Medvedev. The partnership’s priority is enhancing and facilitating trade and investment, and intensifying economic relations in general. The EU focuses here on alignment of technical regulations and standards, on enforcement of Intellectual Property Rights (IPR), on the

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12 The other three common spaces are a common economic space, a common space of freedom, security and justice and a common space of external security.


14 The European Research Area (ERA) is a concept for realising an integrated approach to R&D and innovation within the EU.

functioning of the judiciary and the fight against corruption. But the partnership also includes as priority area enhancing cooperation in innovation, research and development, and space.\textsuperscript{16}

Another step in intensifying cooperation would have been an association of Russia to the EU Framework Programme for RTD. Accordingly Russia declared in spring 2008 its interest in becoming associated to the FP. Policy makers welcomed this interest and “noted that an eventual association of the Russian Federation to the 7th Framework Programme on Research and Technological Development would take Russia-EU scientific and technological cooperation to a new qualitative level. They stated that the European Research Area would be enriched and strengthened by Russia also becoming a full part of it”.\textsuperscript{17} However, negotiations on the FP7 association were not opened, and an association to the upcoming Horizon 2020 is currently not on the agenda.

3.1.1 EU Framework Programme for RTD

The main practical instrument for R&D cooperation at the multilateral level is the EU’s Framework Programme for Research and Technological Development (FP). It can be observed that Russia has consistently one of the highest participation of all “Third Countries” (countries not being EU Member States (MS) or countries associated to the FP (AC)) in the past FPs and the current FP7 (2007-2013).\textsuperscript{18} Russia participates therefore in this cooperation framework in more projects with EU MS/AC partners and receives more EU funding than competitors such as China or India.

According to FP6 data from the European Commission referring to the period 2002-2006, Russian teams were involved in 312 projects funded in the different sub-programmes of FP6 (including EURATOM). In these projects 470 Russian teams participated and received an EC contribution of around € 50 million.\textsuperscript{19} Most projects with Russian participation were funded in the following scientific fields of FP6 in order of importance (citing here only the top three priorities):
- Sustainable development, global change and ecosystems
- Nanotechnologies and nanosciences
- Information society technologies (IST)

In the FP7, Russia is still the strongest “Third Country” performer. The country ranked first in terms of funding received in FP projects and in the number of participants in the funded projects, and therefore ahead of other third countries such as the USA, or the other BRICS. There have been 463 Russian participants in 291 signed grant agreements, receiving an EU contribution of € 63 million with status December 2012.\textsuperscript{20}

\textsuperscript{17} European Commission 2008. Eastern Europe and Central Asia Meeting doc. 137/08, Joint Statement of EU-Russia Permanent Partnership Council on Research, Ljubljana, 27.05.2008.
Most projects with Russian participation have been funded in the FP7 subprogrammes People (101 projects), Transport (TPT – 51 projects), and Knowledge Based Bio Economy (KBBE – 43 projects). Then follow the programmes ICT (31 projects), Space (SPA – 27 projects), Environment (ENV – 25 projects), Nanotechnology, Materials and New Processes (NMP – 24 projects), Infrastructure (INFRA – 23 projects), Health (21 projects), Energy (13 projects) and Fission (11 projects). All other FP7 subprogrammes (e.g. SME, etc.) have less than 10 projects with Russian participation. These data depend of course on the size (in terms of available budget) of the respective FP7 subprogrammes.\(^{21}\)

**FIGURE 2: Number of funded projects in FP7 subprogrammes with Russian participants\(^{22}\)**

The financial support provided by the EU to these Russian teams cannot be specified precisely; over the FP7 period up to June 2012, it exceeds €50 million. The highest success rates of proposals with Russian participation can be observed in the Nuclear Fission programme: out of 20 submitted proposals with Russian participation, 11 were selected for funding. This gives a success rate of 55%. Programmes with around 30% success rate of proposals with Russian participation are Knowledge Based Bio Economy, Transport, Space and the People programme. Most projects with Russian participation were submitted in the People programme (375 projects) and the ICT programme (324 projects). In the latter one, proposals with Russian participation reach a success rate of only slightly below 10%. The lowest success rate for proposals with Russian participants was registered with 2.3% for the European Research Council; only one out of 44 proposals was funded. These success rates depend on involvement of Russian partners in competitive consortia, but also on the overall competitively of an FP7 subprogramme.

Russian teams and researchers may participate in project proposals to standard calls of FP7 sub-programmes and receive funding. In addition, they can participate in Specific International Cooperation Actions (SICA), which are calls for proposals for specific scientific topics relevant in cooperation with certain world regions within the FP7 sub-programme “Cooperation”. Some of the SICA-calls were targeted at Russia and the whole Eastern European and Central Asian (EECA) region.

\(^{21}\) Data provided by the European Commission in June 2012.

\(^{22}\) Source: European Commission, 2012.
Within the FP7, the EU has created with the “Coordinated Calls”, a specific instrument for cooperation with major international S&T partners. With this instrument jointly funded calls for project proposals are launched in the frame of a standard call of the FP7 sub-programmes “Cooperation” or “EURATOM”. The specific topics of a coordinated call are jointly defined by the funding partners. Most such coordinated calls the EU has launched with Russia. This reflects the mutual interest in intensifying R&D cooperation, but also the enhanced financial capabilities of Russia to fund R&D.

Working Groups for the different thematic priorities have been set up for this purpose. They are mainly composed of experts from the European Commission, from the Russian Ministry of Education and Science, from other Russian ministries and agencies, and of scientists. Call procedures and specific topics are agreed in these Working Groups. The Russian participants in projects selected for funding in such coordinated calls are funded mainly via Russia’s major funding programme, the Federal Targeted Programme R&D in Priority Fields of Russia’s S&T Complex (2007-2013). Joint EC–Russia Thematic Research Working Groups have been established in the following priority research areas of joint interest:

- Aeronautics
- Energy
- Environment
- Health
- ICT
- Knowledge Based Bio Economy
- Nanotechnology, Materials and New Processes
- Nuclear Fission
- People (Mobility)
- Space

Coordinated calls between the EU and Russia have been agreed until now in the following areas:

- Aeronautics
- Energy
- Health
- ICT
- Knowledge Based Bio Economy
- Nanotechnology, Materials and New Processes
- Nuclear Fission

Such calls have only limited budgets (of up to € 10 million) and only few projects are supported (1-5). They involve significant co-funding from Russia. The co-funding mode is on a 50-50 basis, and Russian teams in projects selected for funding receive their funding mainly from the Russian Ministry of Education and Science, or depending on the topic from other line ministries (e.g. Ministry of Industry and Trade).

While Russia’s FP7 association has not realised, another funding cooperation tool besides coordinated calls is available with European Research Area (ERA)-NET projects. Russian funding organisations have participated or are still participating in the following thematic ERA-NETs (status July 2013):

- **BONUS** - Baltic Sea Science – Network of Funding Agencies: [http://www.bonusportal.org/](http://www.bonusportal.org/) was an ERA.NET project implemented under FP6 in the years 2004–2008. Under FP7, Bonus continued as an ERA.Net PLUS project and implemented a call with Russian participation (through RFFI). Bonus has meanwhile
evolved to a European Economic Interest Grouping (EEIG) and a joint research programme with EU participation according to article 185 of the EU Treaty (TFEU). Russia is not yet a member of the Bonus EEIG.

- **EUROPOLAR** - The Strategic Coordination and Networking of European Polar RTD Programmes [http://www.europolar.org/](http://www.europolar.org/) was implemented under FP6 in the years 2004-2008.
- **ERA-IB 2** - the ERA-NET "Towards an ERA in Industrial Biotechnology" 2 [http://www.era-ib.net/](http://www.era-ib.net/) is a follow-up project to ERA-IB. The Russian FASIE participates in this ERA-NET as funding partner since 2011.
- **ASPERA 2** – an ERA-NET on Astroparticle Physics [http://www.aspera-eu.org/](http://www.aspera-eu.org/). The Russian funding partner is the RFBR.
- **EUPHRESCO 2** - European Phytosanitary Research Coordination II [https://secure.fera.defra.gov.uk/euphresco/index.cfm](https://secure.fera.defra.gov.uk/euphresco/index.cfm) The Russian partner is the All-Russian Plant Quarantine Centre (FGU VNIIKR).
- **EraSME** - [http://www.era-sme.net/era-sme/](http://www.era-sme.net/era-sme/), is an ERA-NET for stimulation of SME cooperation in innovative projects. EU funding has stopped, but the EraSME continues at a smaller scale. The Russian FASIE participates in this ERA-NET since February 2013.
- **SUMFOREST** – an ERA-NET to start in the second half of 2013 in the area of wood. A call with participation of the Russian Forest Technology Platform is planned.

A regional ERA-NET specifically targeted at cooperation with Russia, is the ERA.Net RUS project. This project is discussed in more detail in the following chapter.

**Institutional solution**

The EC–Russia S&T policy dialogue includes, at ministerial level, the Permanent Partnership Council (first meeting in May 2008), the joint EC–Russia S&T Cooperation Committee (under the S&T cooperation agreement); and several joint EC–Russia Thematic Research Working Groups in common priority areas of research (Nano-technologies & New Materials, Health, Food-Agriculture-Biotechnology, Non-Nuclear Energy, Nuclear Fission, Aeronautics, ICT, and Mobility).

**3.1.2 ERA.Net RUS Joint funding programme**

Currently, it is foremost the ERA.Net RUS, which serves as a platform for new R&D and innovation funding mechanisms.²³ The ERA.Net RUS project is funded by the EU under FP7. The project consortium includes 20 organisations from 10 countries, among them several Russian partners (e.g., the Russian Academy of Sciences, the Russian Foundation for Basic Research).

ERA.Net RUS aims at coordinating bilateral funding programmes of EU Member States (MS) and countries associated to FP7 (AC) with Russia. The project runs from 2009-2013. Its main goal is the implementation of two Pilot Joint Calls, one for R&D and one for innovation projects. The pilot calls have been launched in 2011 and have been jointly managed and

funded by R&D and innovation funding bodies from EU MS/AC and Russia. For each call a Group of Funding Parties (GFP) has been established as a steering and decision making body. In the GFP each funding organisation participating in one of the ERA.Net RUS calls is represented. Furthermore two Scientific Councils have been established, for which each funding organisation has proposed a scientist. The councils have served as advisory bodies for project selection. Finally a central administration situated at the ERA.Net RUS project coordinator International Bureau of the BMBF (IB-DLR, Germany) has taken care of the call management.

The call for innovation projects has involved funding agencies from Germany, Greece, Israel, Russia, Switzerland, and Turkey. The call was launched on 15 February 2011 and applicants were able to submit online proposals until 15 April 2011. The call budget was approximately € 3 million. From a thematic point of view, the innovation call was open to proposals from all different scientific fields and topics. Overall, 68 proposals were submitted, out of which 52 were eligible for funding. A peer review of the proposals was organised centrally by the ERA.Net RUS call secretariat. It was performed by external experts. As a result of the review, 11 proposals were selected for funding in a selection meeting. This gives a success rate of 21%. The projects have received support for a two year period and are currently in the implementation phase.

The call for R&D projects was approximately double in size as compared to the innovation call. It involved funding partners from Estonia, Finland, France, Germany, Greece, Norway, Poland, Russia, Spain, Switzerland, and Turkey. The call was launched on 16 March 2011 and applicants were able to submit online proposals until 31 May 2011. Thematically the call was focussed on four broad thematic areas, which were further specified in sub-topics:

- **Innovative materials and cutting edge technological processes**
  - ultrahigh-power laser sources
  - intelligent materials and nanomaterials
  - quantum optics
- **Environmental research and climatic change**
  - biodiversity and ecophysiology of natural ecosystems
  - climate change in the arctic and subarctic regions
  - Material sciences connected with energy conversion and storage
- **Research on serious human health problems**
  - viral infections: HIV and Hepatitis
  - auto-immune diseases
  - neurodegenerative diseases
- **Contemporary socio-economic studies**
  - Social security systems and welfare state (in the context of globalization)
  - Labour, labour market, and employment
  - Transformation of the educational system

The call had a budget of approximately € 6 million. The project selection process in this call for R&D projects proved to be lengthy due to the coordination efforts among the funding parties and was finalised only in May 2012. Out of a number of 183 eligible proposals, finally 31 proposals were selected for funding. This resulted in a success rate of 17%. Partners involved in the selected projects receive funding from their national funding agency. The funding agencies also supervise the project implementation.

**Institutional solution**
A Group of Funding Parties (GFP) has been established as a steering and decision making body for each funding instrument within ERA.Net RUS. In the GFP each funding organisation participating in a certain ERA.Net RUS call is represented. As an advisory body, a Scientific Council has been established, for which each funding organisation has proposed a scientist. Finally a central administration situated at German, French and Russian funding parties has taken care of the call management.

3.1.3 COST and EUREKA

Russian scientists and teams participate in projects of the European initiatives COST and EUREKA. COST (European Cooperation in Science and Technology) was established in 1971 and supports networking among researchers of its member states. Researchers from other international partners may, however, also participate in COST actions. With status December 2011, Russian researchers have been involved in 42 running COST actions. Russia is herewith on third place in participation rates among non-member countries of COST (after Australia and the USA).  

EUREKA was established in 1985 to promote market-oriented research and innovation through the support to small and medium-sized enterprises, large industry, universities and research institutes. Since 1993, Russia is member of EUREKA. National Project Coordinators (NPC’s) are at the national level the contact persons for the EUREKA programme. The Russian NPC is located at the Skolkovo Foundation. Russia is not yet member of EUROSTARS, a EUREKA funding tool established in recent years for bringing innovations to the market. Russian partners may participate in EUROSTARS projects, but without funding support from this programme. Overall, 102 projects with Russian participation were supported in the EUREKA framework since the country became a member. In 2011, of this sample, 18 projects were still ongoing, including three EUROSTARS projects. Russian participation was over the last 10 years fairly stable with on average around five project participations per year. But participation of Russian organisations is rather low in comparison to the duration of the country’s involvement. This confirms the limited innovative capacities and limited number of innovative SME’s within Russia.

3.1.4 INTAS

A specific funding programme relevant for EU–Russia R&D and innovation cooperation was INTAS, the International Association for the promotion of cooperation with scientists from the New Independent States of the Former Soviet Union. INTAS was set up in 1992 and was operational until 2010. It was linked to and received the main share of its budget from the European Framework Programme for RTD (FP). A General Assembly was established as highest decision making body, where all INTAS member states were represented (EU Member States and nearly all countries associated to FP6). A Scientific Council had an advisory function, especially for project selection. It was composed of scientists from both EU MS/AC and FSU countries. A Secretariat situated in Brussels took care of day to day management of the programme.

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25 Data from the EUREKA database: www.eurekanetwork.org, last accessed on 6 September 2011.
INTAS funded research projects involving teams from EU MS/AC, and from Former Soviet Union countries (and hereof mainly from Russia). Other funding tools were grants for young scientists from Former Soviet Union countries and innovation grants. Over the period of FP6 from 2002-2006, INTAS funded 420 research projects, involving more than 800 teams from Russia. During this period, Russia received as a result of its successful participation in INTAS calls an amount of around € 50 million of R&D support from the EU, in addition to funding through other FP6 action lines.\textsuperscript{26} INTAS was mostly a thematically bottom-up programme supporting basic research, especially in fields where Russia is traditionally strong, such as Physics, Life Sciences, and Chemistry. It was complementary to other FP action lines, as it supported smaller scale projects of up to € 300,000 per project and smaller project consortia involving four to five research teams usually.

\textbf{Institutional solution}

A General Assembly was established as highest decision making body, where all INTAS member states were represented (de-facto EU Member States and Associated Countries), but not the target countries of cooperation (Russia and other FSU countries). A Scientific Council had an advisory function, especially for project selection. It was composed of scientists from both EU MS/AC and FSU countries. A Secretariat situated in Brussels took care of day to day management of the programme.

\subsection{3.1.5 ISTC}

A multilateral S&T cooperation forum is the International Science and Technology Center (ISTC), situated in Moscow. It involves (except China). It was founded in 1992 as an international organisation by Russia and its main research partners, the EU, Japan, and the USA. A Governing Board is the primary decision making body, which is composed of representatives of the main partners and in addition one yearly rotating seat for a representative of other CIS member states (Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan). A Scientific Advisory Committee (SAC) provides evaluation of project proposals, proposes new directions for project activity, and evaluates ongoing projects. A Secretariat based in Moscow is dealing with the day to day management of the programme.

Through the ISTC substantial support to the Russian R&D sector has been provided with the aim of conversion of military to civilian research. Civilian research projects are supported, which must involve normally at least 50\% former weapons scientists. Researchers from Russia’s international partner countries in the ISTC have usually provided managerial and scientific guidance in such projects, although this pattern has been changing in recent years to more collaborative research efforts between Russian and foreign colleagues.

The relevance of the ISTC has been declining over recent years. Until 2007 slightly more than € 20 million were invested annually through the ISTC in the Russian S&T sector by the EU. But EU contributions to the ISTC were slashed to reach around € 5 million in the year 2009.\textsuperscript{27} Since then, they have been further decreased. In summer 2010, then Russian President Medvedev signed a decree on the withdrawal of Russia from the ISTC.\textsuperscript{28} Consequently, the ISTC activities will be winded down in Russia until 2015 and the main ISTC office shall in the future be located in Kazakhstan.

\textsuperscript{26} INTAS 2007. A bridge to partnership in research. Activities over the FP6 Period 2002-06. Brussels.
\textsuperscript{27} Spiesberger, 2008.
\textsuperscript{28} Decree No. 534-rp of the President of the RF, 2010.
Institutional solution
The ISTC is established as an international organisation, including USA, EU, Japan, Canada and Russia as main partners. A Governing Board is the primary decision making body, which is composed of representatives of the main partners and in addition one yearly rotating seat for a representative of other CIS member states (Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan). A Scientific Advisory Committee (SAC) provides evaluation of project proposals, proposes new directions for project activity, and evaluates ongoing projects. The SAC is composed only of scientists from the main partners. A Secretariat based in Moscow is dealing with the day to day management of the programme.

3.2 Russia’s bilateral RDI cooperation with EU MS/AC
Russia has concluded bilateral Science and Technology agreements with a broad range of EU Member States and countries associated to the FP. According to the Russian Ministry of Education and Science,29 the Russian Federation has active agreements in place with thirteen of the twenty seven EU Members States (Bulgaria, Czech Republic, Finland, France, Germany, Hungary, Italy, Poland, Romania, Slovakia, Slovenia, Spain, and United Kingdom) and with five countries associated to FP7 (Croatia, Israel, FYR of Macedonia, Serbia and Turkey). Agreements with Austria, Netherlands, Norway and Switzerland were previously active, but are still in the process of renewal. Bilateral joint committees have mostly been established to take care of joint funding programmes.

Agreements have been established similarly on the level of research funds and research organisations. Several of these agreements have resulted in substantial cooperation in the form of joint funding of R&D projects or more comprehensive joint funding programmes. On the Russian side, the Russian Foundation of Basic Research (RFBR), the Russian Foundation for Humanities (RFH) and the Russian Foundation for Assistance to Small Innovative Enterprises (FASIE) have established programmes with European counterparts. Among research organisations, especially the Russian Academy of Sciences (RAS) has a dense network of cooperation agreements in place with Academies in EU MS/AC.

In the frame of the ERA.Net RUS project around 140 R&D and innovation funding organisations, including ministries, research funds and research organisations involved in R&D funding (e.g. Academies of Sciences), were contacted in 2009 in EU Member States and countries associated to FP7. They were approached with an online survey. Of this sample 40 organisations provided substantial information on their cooperation activities and joint R&D and innovation funding programmes with Russia. For nearly all other R&D and innovation funding organisations, we can state that they have either no significant cooperation with Russia or no cooperation at all. Intensity of cooperation was measured in terms of budget invested in cooperation with Russia and in numbers of projects supported. The assessment included also thematic areas supported, as well as perspectives and barriers to cooperation.

Survey findings indicate that cooperation of EU MS/AC with Russia is ongoing mainly in basic research (29 of the responding organisations fund basic research), while support for applied research (17 of the responding organisations), and especially for innovation activities (8 of the responding organisations) is provided by considerably fewer organisations. Topics cited most frequently as relevant for cooperation are the following (in order of importance):

- Nanotechnologies/Materials
- Energy

Joint funding programmes with a Russian funding partner (as opposed to unilateral funding schemes) were mentioned to be implemented by 21 responding organisations. Instruments used for support of R&D and innovation cooperation with Russia concern most frequently support of mobility: out of 40 responding organisations, 30 use this instrument. Funding of R&D and innovation projects, and dissemination of R&D and innovation results are supported by slightly more than 20 organisations each. When it comes to more institutionalised and mature cooperation instruments, such as access to R&D infrastructure and joint laboratories, the number decreases to 12 and 9 supporting organisations respectively.

**FIGURE 3: Funding instruments used for R&D cooperation**

![Bar chart showing the number of responding organisations using different funding instruments.]

Budgetary figures of bilateral R&D and innovation programmes for the years 2006-08 show that these programmes are mostly small scale and annual investment is usually below € 1 million. But there are some statistical outliers, where investment is well above these levels. The top performers in investment in cooperation with Russia are funding bodies in northern Europe. The Research Council of Norway (RCN) is here in the leading position with a budget of more than € 12 million in 2008. Second comes the German Research Foundation (DFG) with an estimated annual budget of around € 8 million. Academy of Finland (AKA) is third with a budget of € 3 million in 2008, but with the double of that budget in the previous year 2007.

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31 Regarding budgets of bilateral programmes, the aim is to show a general picture of cooperation intensity, therefore funding for all different instruments, such as mobility support, R&D projects, conference support, etc. have been summed up. Also, figures are compared over different types of research funding bodies, covering ministries, research funds and research organisations.
In 2008 R&D funding programmes with Russia have been set up by the Austrian Science Fund (FWF), the Helmholtz Association (Germany) and The Scientific and Technological Research Council of Turkey (TÜBITAK) in co-funding arrangements with the Russian Foundation for Basic Research (RFBR).\textsuperscript{32} Funding amounts to more than € 2 million for FWF and to € 1 million for Helmholtz respectively.\textsuperscript{33} A unilateral funding programme was also established in 2008 by the Swiss State Secretariat for Education and Research (SER) with a budget of approximately half a million €. Interestingly, against the trend of establishing new bilateral programmes and as a result of a strategic refocusing, the Netherlands Organization for Scientific Research (NWO) stopped a substantial joint funding programme with RFBR in 2006.

**FIGURE 4: Annual budgets for R&D and innovation programmes with Russia**
(in million EURO, amounts/data labels for 2008)\textsuperscript{34}

For applied research and innovation joint co-funding programmes were put in place in 2008 between the Russian Foundation for Assistance to Small Innovative Enterprises (FASIE) and the French Innovation Agency OSEO, as well as with the German International Bureau/Federal Ministry of Education and Research (IB). Another programme was established between FASIE and the Finnish innovation agency TEKES in 2011.

An important player in R&D cooperation with Russia on the EU side is France and especially its National Center for Scientific Research (CNRS). It has the highest number of projects supported per year and is also among the leaders in budgetary terms. It needs to be taken into account that CRNS is a research organisation and budgetary figures do not fully express the volume of cooperation, as labour costs are mostly covered from other CNRS budget lines and not the cooperation programme with Russia. Furthermore CNRS data on projects give evidence of an institutionalisation of cooperation characterised by a shifting of support from

\begin{itemize}
\item Co-funding in these schemes means, that project related costs of Russian teams are funded by RFBR and for teams from EU MS/AC from their respective funding organisation.
\item Budgetary figures for TÜBITAK have not been included in the chart below, as payments to funded projects started only in 2009.
\item Source: ERA.Net RUS survey, 2009. Non-€ currencies have been converted according to the ECB rate as on the 31\textsuperscript{st} December of the respective year. The budget for DFG/DE is an estimate.
\end{itemize}
mobility projects to R&D projects and to joint French-Russian laboratories, which are involving more researchers. Another relevant development concerns the evolution of bilateral towards multilateral schemes. An example of this evolution is the funding of joint French-German-Russian laboratories by CNRS, DFG and RFBR.

Other substantial investors in RTDI cooperation with Russia are the Austrian Federal Ministry of Economy, Family and Youth (BMWFJ) and the Israeli Ministry of Science and Technology (MOST).

A comparison of budgetary figures with number of projects that are annually supported by funding organisations in EU MS/AC (see figure 4 below) shows that the ranking of funding organisations is different.

**FIGURE 5: Number of projects with Russia supported per year (data label for 2008)**

While CNRS and DFG are on the top of project numbers and leading in budgetary figures, we can see that the Academies of Sciences support a large number of small scale mobility projects for exchange of individual researchers. Especially in Central and Eastern European Countries, institutions such as the Hungarian Academy of Sciences (MTA) and the Polish Academy of Sciences (PAN) have strong links to the Russian Academy of Sciences. A relevant number of smaller scale mobility and R&D projects are supported by the Spanish National Research Council (CSIC) and the Slovenian Ministry of Higher Education and Science (MHEST). RCN and AKA, top performers in terms of budget, support few (slightly less than 20 projects per year) but financially potent projects.

Comparison of budgetary figures and number of projects supported in bilateral programmes is fraught with several methodological problems: some funding organisations have permanent funding activities, while others launch calls not every year. Funding sizes per project are quite differently calculated and range from few € 100 for mobility support per year to more solid support of R&D projects with more than € 100,000 per year. Typically, research funds

36 The calculation is not always based on full costs, but sometimes additional cost-models are in use. Sometimes calculation is based on lump sums.
provide more solid funding. They regularly support labour costs, which is the cost category absorbing usually most financial resources. Research organisations such as the Academies of Sciences provide usually only support for mobility (travel, daily allowances), as they support researchers affiliated to their organisation and whose labour costs are covered from their basic funding. Mobility programmes cannot sharply be differentiated from more substantial R&D funding programmes, as mobility is often based on R&D project proposals and definitions vary largely among funding bodies.

Recording coherent budgetary data is hampered by lack of data, different calculation schemes and price levels (figures do not reflect purchasing power parities). Budgetary data reflect mostly only the share of costs for EU MS/AC researchers and organisations, and the Russian co-funding share needs to be considered to identify the full project funding size. However, in some cases funding from EU MS/AC organisations may cover also part of the expenses of Russian scientists or teams, depending on the funding instrument and the organisation. These factors should be taken into consideration when interpreting data.

Survey data indicate that comprehensive cooperation with Russia has been developed between some of the bigger EU countries such as France and Germany, which ranges from mobility schemes, funding of joint research projects, co-funding of research infrastructure to joint laboratories. Also smaller EU countries such as Austria, Finland and Greece and countries associated to FP7 such as Israel, Norway and Switzerland have substantial cooperation ongoing on bilateral level with Russia and have established joint mobility and research funding schemes. Most responding funding organisations were planning to continue and some even to increase cooperation with Russia.37

Institutional solution
Bilateral joint committees have mostly been established to take care of joint funding programmes.

3.3 Cooperation in the frame of Russian national funding programmes
Russian national funding programmes for R&D are in principle open to participants from EU Member States. This openness is based on the principle of reciprocity. As the FP7 and its subprogrammes are accessible for Russian researchers, so are Russian funding programmes reciprocally accessible for researchers from the EU countries. The most relevant Russian programmes for cooperation with the EU are the following:38

3.3.1 Federal Targeted Programme R&D in Priority Fields of the S&T Complex of Russia (2007-2013)
The Federal Targeted Programme (FTP) R&D in Priority Fields of the S&T Complex of Russia (2007-2013) is Russia’s main programme for funding of R&D and innovation activities. It is managed by the Ministry of Education and Science and runs from 2007-2013. In the period 2007-2011, European organisations have taken part in 153 projects funded under this FTP. Organisations from Germany, UK, Italy, France and Switzerland have the highest

37 This trend was confirmed already in an earlier survey of S&T policy makers from EU MS/AC in the EU’s CREST Working Group on Internationalisation of S&T. See Spiesberger, 2008.
38 See on the topic of participation of EU researchers in Russian programmes several deliverables of the FP7 funded ACCESSRU project, e.g. D 2.4 Opportunities Report for EU R&D actors, accessible at: http://www.access4.eu/russia/182.php
participation rates. There are significant numbers of projects involving external partners in the areas of basic technology and ICT.\footnote{Joint EU-Russia S&T Cooperation Committee, Draft Minutes, Wednesday 29 June 2011, Brussels. See: \url{http://минобрнауки.рф/новости/1178}, last accessed on 14 June 2012.}

In this FTP specific calls for international collaboration are launched. In 2011 a call was launched for applied/problem-orientated research projects with research organisations from the EU. The call included targeted actions in industrialised nano-systems and materials, life sciences, energy and energy efficiency, rational use of natural resources and ICT. Other calls were targeted at collaboration between Russia and (1) the US and Canada; and (2) Latin America, the Middle East, Asia and Africa. The largest of these three international calls was the EU-focused call.\footnote{More details on international calls in this FTP can be found in: Shatilova, Ekaterina 2012. Analysis of the International Calls of the Ministry of science and education of the Russian Federation (MON) in the framework of the Federal targeted program “Research and development in priority areas of Russia’s scientific and technological complex 2007-2013” in 2011 and 2012. See \url{http://www.bilat-rus.eu/media/Information_on_MON_calls_2011-2012.pdf}}

### 3.3.2 Federal Targeted Programme Scientific and Scientific-Pedagogical Personnel of Innovative Russia for the years 2009-2013

The FTP Scientific and Scientific-Pedagogical Personnel of Innovative Russia for the years 2009-2013 is a funding programme for support of human resources for R&D. It is also managed by the Ministry of Education and Science.

One of its funding activities targets Russian scientists working abroad (scientific diaspora), including those residing in EU Member States and associated countries to FP7. Those researchers have been attracted for working with research groups in Russia. Two calls for this support scheme were launched in 2009 and 2010: in the first call 110 projects were supported and in the second call 125 projects.\footnote{See \url{http://www.fcpk.ru/}, last accessed on 18 July 2012.}

### 3.3.3 Leading Scientists programme

With the Leading Scientists programme the Ministry of Education and Science tries to attract highly qualified researchers from Russia and especially from abroad, to establish research groups at Russian universities. Leading scientists selected for support have to spend at least four months per year in Russia. This scheme comes with solid funding of approximately €3.5 million per each project for a period of usually two to four years. In 2010 in the first call 40 scientists were selected for support of their projects, whereby half of the scientists have been foreign nationals and only five selected scientists have been permanent Russian residents. Most scientists from abroad have been from the USA (ten - with four having double Russian and US nationality) and then from Germany (seven). Importantly, foreign experts were also involved in the evaluation of proposals. This underlines opening up tendencies of Russia in R&D and innovation. A second call in this scheme was launched in April 2011, and as a result 39 researchers were selected for support. A third call was launched in December 2012 and results announced in April 2013; 42 researchers were supported in this call.\footnote{See \url{http://минобрнауки.рф/проекты/ведущие-вузы/учёные}, last accessed on 8 July 2013.}
3.3.4 Innovation support instruments

Besides these schemes, there are especially cooperation links in the applied research and innovation fields. Partners from the EU participate in activities of the following Russian innovation support tools:

- Rusnano, which is a public venture support tool for close to the market projects in nanotechnologies.
- RVC, which started off as a public venture fund of funds. RVC has broadened meanwhile its field of activities to other innovation stimulation measures, such as innovation brokerage, support for start-ups, etc.
- The Skolkovo Foundation, which is establishing a new innovation centre with international participation on the outskirts of Moscow.

3.4 Conclusions

Russian participation in the EU Framework Programmes, in other European initiatives for R&D cooperation, and in the various bilateral schemes has allowed building a far reaching network of scientific contacts between Russia and the EU MS/AC. Moreover, scientific cooperation between Russian scientists having emigrated to the EU MS/AC and their colleagues back home has been reinforced in this context. Specific EU and international schemes such as INTAS and the ISTC have provided support to the Russian science sector and helped herewith to sustain research capacities in Russia during the years of worst economic crisis in the 1990s.

However, the cooperation patterns have changed over the last years from a support mode to a cooperative mode, with jointly funded and jointly managed activities. Well established support tools, which financed in first place researchers in countries of the Former Soviet Union (and especially in Russia), were abolished or are in the process of being winded down (e.g. INTAS, ISTC), while new cooperative instruments have been developed. Coordinated calls in the FP between the EU and Russia are one such new instrument. They are based on co-decision making on topics and procedures and on co-funding of projects. This strengthens ownership of this activity and perceptions of cooperation on a par, a fact especially important for Russia. But Russian co-funding is also relevant for the EU. European funding for Russian teams within the FP becomes more and more difficult to be justified, as Russia is a country disposing today of sufficient financial resources for funding of research activities.

An increase in cooperation and the higher financial potential on the Russian side is confirmed by new multilateral and bilateral funding tools, into which both the RFBR and the FASIE, Russia’s major funding agencies, have entered. Both agencies participate in ERA.Net projects and both have agreed new bilateral cooperation schemes with EU partners. FASIE, for example, has established a funding scheme with Finnish partners (TEKES) in 2011. In these schemes, Russian researchers and research teams are funded by the Russian agencies. This reflects the fact that Russia has become economically significantly stronger over the last ten years.

Another relevant trend among bilateral schemes is an evolvement towards trilateral and multilateral funding programmes. For example, RFBR, CNRS and DFG have agreed to fund joint laboratories. This indicates also a trend to more substantial cooperation. Small scale mobility schemes are losing in importance, while more significant funding in the framework of calls for research projects, joint labs or other activities becomes more relevant.

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43 This is evident from project consortia, which were supported in these programmes. Several consortia included Russian scientists situated in EU MS/AC.
These trends are taken up to some extent in the regional ERA-NET targeted at Russia, the ERA.Net RUS. It aims at coordinating bilateral funding schemes of EU MS/AC with Russia. It offers perspectives and options for scaling-up of joint funding activities. In 2011-2012 two jointly funded calls for projects were successfully implemented. Major Russian funding agencies were involved with appropriate Russian financing shares of the calls. A top-up of the call budget was allocated to the ERA.Net RUS calls from INTAS. Funds remaining as a result of the winding-up of the organisation were made available and increased the overall available budget for projects.

A certain effort was undertaken to coordinate the research topics among the funding partners from EU MS/AC and Russia. In a joint consultation and coordination process the partners agreed on four broad thematic areas with a range of specific sub-topics each, for the call for R&D projects. The innovation call, on the contrary, was kept thematically completely open. The ERA.Net RUS consortium intends now to continue its funding activities in the format of an ERA-NET plus project. Joint funding activities will be foreseen for the period 2013-2014. Coordination of thematic fields for joint calls shall be further refined. Expert workshops are planned to be held for specific thematic areas, involving experts from the EU MS/AC and from Russia. In these workshops future promising fields for joint research cooperation will be singled out and launched in a call.

In the longer term future, this ERA-NET cooperation could be further developed into financially and organisationally more substantial formats. An option would be to organise a joint RTDI fund between Russia, the EU and/or EU MS/AC, with financial contributions from the various partners. Another option to be explored would be a cooperation according to article 185 TFEU (Treaty on the Functioning of the European Union). This would involve the participation of the EU and the EU MS/AC, and a significant financial contribution of the EU.44

44 An example for a cooperation according to article 185 TFEU is BONUS, The joint Baltic Sea research and development programme. The cooperation among the Baltic Sea region is highly relevant for Russia too. See www.bonusportal.org
4 Environment of EU-Russia RTDI cooperation

4.1 Status of the Russian National Innovation System (NIS)

After more than 20 years of transition to the market economy Russia has been deeply integrated into the global economy. However, it remains one of the few developed countries that have not been able to achieve visible improvements in building a modern national innovation system (NIS). Moreover, according to expert assessments, the innovation landscape in Russia in recent years has even deteriorated.45 This is particularly noticeable vis-à-vis the trends with major global competitors as well as nearly marginal innovation-related changes in the national economy46.

4.1.1 MAJOR CHANGES AND PROBLEMS

The development of the innovation sphere in Russia is characterized by a complex of structural, resource, and institutional problems and imbalances. Innovation processes are still too weak to influence the socio-economic progress: for a long time they have been in a state of stagnation due to unfavourable macroeconomic conditions, the current structure of the markets, the quality of corporate governance, on the one hand, and the low efficiency of NIS and its institutions, on the other.

According to experts’ estimations, in Russia the key actors in the field of innovation, i.e. businesses directly transforming existing knowledge into products, services, and other economic benefits, remain underdeveloped47. As shown in Figure 6, the level of their innovative activity in industry is under 10%, while in Germany it is almost 72%, in Austria - 49%, in the Czech Republic - 42%.

FIGURE 6: Innovation Activity in Russian Industry48

A definite advantage of the innovation sphere in Russia remains the quality of its human capital, which is generally rated by international experts higher than the overall level of innovative activity (38th according to the Global Innovation Index, e.g. by the quality of university education 19th). However, the discrepancy between the structure and quality of professional training and the needs of an innovative economy is growing. Employers are forced to retrain recent graduates, while some university graduates with excellent qualifications are unable to apply their knowledge in science and high technology and have to retrain or to complete their education abroad (to be awarded an internationally recognized qualification) or to find employment abroad. The share of highly qualified engineers, innovative entrepreneurs, and professional managers is negligible.

Paradoxically, Russia, having inherited one of the most powerful S&T potentials in the world, twenty years after the collapse of the Soviet Union is only 44th in terms of this potential's level. The reason is the persistence of the archaic and misbalanced institutional structure, the weak links between innovation actors, and the low overall level of R&D funding.

The R&D sector is dominated by government budget-funded institutions and other forms of organisations with substantial participation of the state. The applied sciences segment is dominated by sectoral (departmental) R&D institutes, whose reform has yet to be launched (with the exception of two waves of corporatization and privatization that ended in the conversion of many organizations and dropping out of academic activities), rather than industrial enterprises, whose share does not exceed 7% of all organizations engaged in R&D. Only 45% of higher education institutions are engaged in R&D, and they accommodate just 7% of the national R&D expenditure total (2.5 times lower than the OECD average).

Budget funding of R&D has been on the rise in recent years and the growth rates are rather high (4 times as much as in 1998). Nevertheless, this sector is still underfunded, which is aggravated by the passive attitude of the business community: the share of the business enterprise sector in gross domestic R&D expenditure was 27.7% in 2011 whereas this indicator exceeds 60% in most of developed countries. As a result, the gross domestic expenditure on R&D (GERD) is as low as 50% of the 1990 level. By the R&D-to-GDP ratio

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50 The Global Innovation Index 2011, ed. S. Dutta. Fontainbleau (France): INSEAD.
(1.12% in 2011), Russia is lagging behind all developed countries (Finland - 3.96%, United States - 2.79%, China 1.54%).

Productivity in the R&D sector remains extremely low, not only in the applied but also in the basic research segments (Table 1). Specifically, by the number of scientific publications in international journals Russia ranks 14th (in 1995 it was 7th, whereas China has ascended from 14th to 2nd position during that period). By citation it ranks 23rd. There is virtually no growth in patenting activity, in particular related to the patents registered by major international patent offices. R&D units have been generally unable to offer to businesses any mass, ready-to-use, cost-effective, technologically competitive solutions and their support and customization in the implementation phase. Other indicators demonstrating low productivity in the R&D sector are: the share in the world high-tech exports (Russia - 0.3%, whereas Singapore, Korea, and Taiwan have between 4–8% each) and technology export (Russia - $0.6 bn, Hungary - $2.7 bn, Finland - $9.1 bn, United States - $89.1 bn).

These and other factors impair the competitive standing of Russian scientists and research teams and prevent their integration into the global S&T area. For industry, technology imports become a mainstream practice, dooming the national economy of a catch-up development model.

There are a number of structural problems peculiar for the Russian National Innovation System. Strong sectoral differentiation of the innovation activity, stratification of the economy according to company’ innovation modes. Even high tech sectors of Russian industry demonstrate indicators that are lower than the averages notable for such economies as Germany and Finland (for example, the share of enterprises engaged in innovation activity in the pharmaceuticals, computer and telecommunication equipment, aerospace industries varies from 23% to 36%).

Innovation activity of enterprises is based mainly on the acquisition of machinery and equipment, rather than on R&D aimed at radical novelties. Less than 1% of innovative products in Russia are new for the world market (in Germany - 13%, in Finland - 16%).

Major gaps between science, education, and business, lack of networking leads to unsustainable and short-term forms of technology cooperation.

At the same time, despite of the overall context of weak innovation activity – efficient non-public centres generating advanced knowledge and technology have been formed. Many small fast-growing export-oriented companies emerging in promising S&T fields (ICT, biotechnology, intellectual services) are integrated into global value creation chains, but mostly cater to foreign customers.

Nevertheless, foreign technology markets remain virtually inaccessible to Russian businesses which are explained by low competitiveness of the majority of industrial companies, R&D institutions, and higher education institutions globally and often nationally. By technology exports Russia is far behind even small European nations (Hungary, Finland, etc.), its share of the global high-technology exports is around 0.25%.
4.1.2 INNOVATION POLICIES

In the 2000s, in the context of rapid economic growth, Russia managed to invest heavily in S&T and innovation and to achieve some success in the development of the NIS\textsuperscript{51}. Mostly, the success was associated with the increased R&D funding from the federal budget and with the implementation of targeted measures to support individual innovative actors. In fact, it was not until just before the crisis of 2008-2009 that the government (at its top level) identified a new direction for the reform, i.e. the transition to a sustainable model of economic growth providing for technological upgrading, mitigation of structural and technological imbalances, stimuli for various participants of the innovation process, comprehensive support of the intellectual potential. This direction was outlined in a set of key strategic documents, namely: the Concept of Long-term Socioeconomic Development of the Russian Federation 2020 (adopted in 2008), Main Directions of Activity for the Government of the Russian Federation 2012 (adopted in 2009), decisions by the Presidential Commission on the Modernization and Technological Development of Russia's Economy, Presidential Council on the Modernisation of Economy and Innovation Development (established in June 2012).

To implement recent strategic documents the following initiatives have started:

- building a system of national research universities (29 currently); support to the development of the innovative infrastructure of higher education institutions and to their cooperation with industrial companies; developing the capacity of R&D and higher education institutions to commercialize the scientific output and technology through small innovative spin-off businesses started by them;
- expanding the system of benefits and subsidies available to R&D institutions and companies involved in technology upgrades;
- building technology platforms;
- instructing state-owned companies to engage in R&D and innovations (drafting of innovative development programs);
- initiating federal target and departmental programs focused on innovation;
- support to the development of the infrastructure of S&T and innovation with the involvement of development institutions, such as the Russian Venture Company, Russian Nanotechnology Corporation, etc.;
- launching projects according to the modernisation priorities (space, ICT, nuclear technology, energy saving and efficiency, medical technology and pharmaceuticals);
- establishment of and substantial budget support to regional innovative clusters, etc.

The recent innovation stimulation measures were focused predominantly on the R&D sector (integration between science and education, centres of excellence, greater opportunities for public research bodies and universities to participate in innovation, etc.), certain indirect incentives (mostly of a fiscal nature), innovation activity of large state-owned companies and regional innovation.

The crisis has made significant adjustments to the understanding of the severity of the innovation challenges, has highlighted the need for a deep adjustment in the innovation policy, and of relevant strategy and policy documents. Weak demand for innovation in Russia’s industry is exacerbated by years of stagnation in the R&D sector, which is incapable to support the required output (even a minor one) and quality of S&T products. This problem

\textsuperscript{51} Russian Innovation Index. 2011, ed. L. Gokhberg. [In Russian]. Moscow: Higher School of Economics.
is system-wide, which means that it can be overcome only through an integrated programme of various thoroughly co-ordinated measures. Primarily, a close, natural, and permanent relationship (interdependence) is required between innovative and basic socio-economic transformations: diversification of the economy, increasing productivity and competitiveness, technology upgrading, improving the institutional environment for effective business activities, building modern development institutions, etc. It is also essential to clearly understand the long-term prospects and risks, development priorities, role of new players, emerging post-industrial sectors and markets, etc.

Today (certainly, without abandoning the efforts already made in the field of tax and customs benefits, corporate regulation, etc.), it is important to design a system of modern tools of innovation policy, to determine the conditions for their effective application in practice. This goal for the national expert community was set by the President of the Russian Federation in his edicts published in May 2012.

According to successful international practices there are several provisional directions of innovation policy to be further developed and implemented in Russia.

The overall socio-economic policy should have a stronger emphasis on innovation (with a focus on higher productivity, market competition, generation, exchange and wider access to knowledge etc.). Innovation (both technological and non-technological) should be stimulated not only in high-tech sectors but also in basic (including low-tech) sectors of industry and services. All kinds of cooperation between stakeholders (government, business, R&D sector et al) should be promoted at all levels (with providing necessary legal and regulation environment). Longer-term strategic objectives should be addressed via integration of innovation-related goals into general long-term development strategies (on the basis of Foresight and other forward-looking activities). In May 2013, there was established Interministerial Commission on Technology Foresight that will be coordinating major Foresight activities in the field of S&T and innovation. The overall support should become more targeted and focused on supporting the best-performing and most active providers of innovation culture (small enterprises, research units, universities et al).

Similarly to other nations, Russia attempts today to overcome the impact of the global crisis and to achieve sustainable growth. Owing to its national peculiarities, the country not only enjoys certain advantages – primarily, its huge natural resources potential and substantial financial reserves – but also faces great challenges in its efforts on this way. Being a part of the global economy, Russia will have to use best global practices to promote R&D and innovation in order to build a competitive National innovation system. One of the key aspects of this process is sustaining and improving Russia’s S&T capacities based on long-term scientific traditions of the country and its high human capital. In this respect increasing scale and efficiency of international cooperation, integration into the global research networks are among the key elements of successful innovation system.
4.2 External Factors important for the EU-Russia cooperation policy development

External factors that could hamper or accelerate EU-Russia cooperation in the field of science, technology and innovation are immanently linked with the global challenges\textsuperscript{52}. Selection of such factors was provided within the project on the basis of the list of global challenges developed in the framework of the Russian S&T Foresight 2030 (that was implemented by HSE in 2011-2013). That list containing around 140 challenges was further revised in order to select the elements most relevant to the cooperation issues. The revised list of external factors (global challenges) consisted of four main groups:

- **Economic factors:**
  1. Increasing of global competition
  2. Global economic crisis
  3. Creation of new technological platform for the global economy and relevant structural changes in various sectors of economy
  4. Emergence of new models of economic development, including the transformation of global value chains

- **Environmental factors:**
  1. Depletion of strategic mineral resources, search for the new sources of energy and energy security
  2. Increasing of energy prices
  3. “Green economy” and "green growth", associated with the transition to the "non-carbon" society
  4. Increase in the number of natural disasters
  5. Constraints related to higher environmental standards

- **Social and political factors:**
  1. Intensification of conflicts in several world regions
  2. Threats of terrorist attacks
  3. Increased importance of human capital for the economic development
  4. Aging population, changing lifestyle, growth of cancer, cardiovascular and infectious diseases

- **Science and technology factors:**
  1. Fast growth of technological capacities providing a background for further economic development
  2. Sustained and increased importance of ICT for the economic development;
  3. Growth of interdisciplinary R&D, including in socio-economic field and humanities.

There were also identified the most important challenges specific for Russia that will affect the EU-Russia cooperation, including following:

1. Dependence of the Russian economy from the global trends
2. Exhaustion of the basis for development based on export of raw materials
3. High proportion of finished goods and high-tech products in the Russian import
4. Deterioration of the Russian manufacturing base

\textsuperscript{52} Often also referred to as “Grand Challenges”.

5. Unfavourable demographic changes
6. Large area of the country
7. Increasing costs of extracting mineral resources in remote areas
8. Low level of innovative activity

The major challenges for the EU development (formulated in the Horizon 2020 programme) are to a large extent consistent with the above listed global challenges:

1. Health, demographic change and wellbeing
2. Food security, sustainable agriculture, marine and maritime research and the bio-economy
3. Secure, clean and efficient energy
4. Smart, green and integrated transport
5. Climate action, resource efficiency and raw materials
6. Inclusive, innovative and secure societies

Thus the global and Russia-specific challenges were considered as key external factors to be taken into account while selecting major priorities the EU-Russia cooperation development and designing relevant policy instruments.

4.3 Framework conditions for cooperation

RTDI cooperation is one of the less problematic areas in the Russia-EU relations and has an impressive track record. Strengthening of the S&T&I cooperation between the EU and Russia is an essential element of the Strategic Partnership and will contribute sustainably to the Partnership for Modernization Initiative. However, in the past decade major changes occurred in both the EU and Russian S&T policy. In order to foster R&D collaboration the EU and Russia still need to build a strategic joint research and innovation agenda, find ways to joint or complementary R&D programmes, and to increase investment in joint R&D projects.

Global and regional integration

In the era of globalisation it is especially important to take into account the changes on the international arena. There are several external factor that have an essential impact on Russia-EU RTDI relations. First of all the global competition in science may redirect the focus of S&T cooperation of both parties to other large countries and regions. The shift of economic, political and scientific power towards Asia, enhancement of BRICS and APEC change preferred cooperation directions for Russia. Still the territorial proximity, proximity in cultures, and an already significant integration of the Russian S&T sector in the European Research Area along with ever-growing though still unbalanced academic mobility contribute to the enhancement of yet rather successful RTDI cooperation.

The active formation of the Eurasian Union also may impose controversial impact on Russian-EU relations. On the one hand Russia will have to commit to responsibilities taken under the Eurasian Union agreements, but on the other hand the Eurasian integration may provide opportunities to extend EU-Russia cooperation towards Kazakhstan and Belarus, which have a certain S&T potential as well.

Moreover the advancement of the EU as a military power provokes discretion in the Russian foreign policy toward the EU thereby slows down the S&T cooperation because of growing security impact of dual use technologies.
New financial and economic recessions, especially concerning the still unsettled roadmap on energy, will have an impact on R&D funding in the EU and Russia. Russia’s accession to the WTO (in 2011) and the OECD (in 2013) on the one hand have not significantly improved the business climate in the country. On the other hand these means the alignment of national standards and regulations with the internationally recognized ones.

**Legal base for Russia-EU RTDI cooperation**

The European Union (EU) and Russia have confirmed their joint commitment to further develop the EU-Russia Strategic Partnership. Both parties are currently working on the New Basic Agreement between EU and Russia, that will replace the current EU-Russia Partnership and Cooperation Agreement (PCA) of 1997. The New Agreement should reflect the political, economic and social changes that both the EU and Russia have undergone during the nearly twenty years since the conclusion of the PCA in 1997. At the St. Petersburg EU-Russia Summit in May 2003, the partners agreed to reinforce their cooperation by creating four “common spaces” in the framework of the PCA and on the basis of common values and shared interests. One of the Common Spaces is on Research and Education, including Cultural Aspects, the others being the Common Economic Space, the Common Space on Freedom, Security and Justice, and the Common Space of External Security. At the Russia-EU summit in Moscow in May 2005 the Roadmaps for the Common Spaces were adopted.

Currently the legal basis for EU-Russia S&T&I cooperation is mainly shaped by the following documents:

- Agreement on Partnership and Cooperation concluded between the Russian Federation on the one part and the European Communities and their Member States on the other part, signed on 24 June 1994, in force since 1 December 1997.
- Agreement on Cooperation in Science and Technology between the Government of the Russian Federation and the European Community, signed on 16 November 2000 and prolonged for two 5-year terms.
- Agreements between the Government of the Russian Federation and the European Atomic Energy Community on (1) cooperation in the field of nuclear safety, signed on 3 October 2001 and (2) cooperation in the field of controlled fusion energy research, signed on 3 October 2001.
- Partnership for Modernisation initiative between the European Union and Russia, targeted on the development of strategic partnership, launched at the EU-Russia summit in Rostov-on-Don in 2010 and including S&T&I as an important element.

Moreover, on the bilateral level Russia has in force S&T Agreements with 15 of the 27 EU member states, and with 6 EU member states - agreements that address science or technology issues.

The strategic agenda of EU-Russian cooperation in field of RTDI is implemented by the Joint S&T Cooperation Committee that was established in May 2006. The Committee set eight EU-Russia Working Groups (WG) in different fields of S&T and forms of cooperation (Life Sciences and Health Research; Biotechnologies and Agro-Food Research renamed to Biotechnology Research; Nanotechnologies and Materials; Civil Aeronautics Research; Energy Research, later divided into two subgroups Electricity and Biomass; Nuclear Energy Research; Environmental Research; Information and Communication Technology Research). WGs provide a good platform for discussion, sharing best practices and launching activities of mutual interest. In 2010 series of legislative steps to improve and streamline the legal framework for research have been taken in Russia: the Federal law on developing spin-offs from public research organisations; the establishment of the network of national research universities; a call for tenders to attract leading scientists to Russian research universities.
Visa issues still remain an unsettled topic that hampers academic mobility. Although it is discussed on every governmental and ministerial meeting, no significant improvements have been made. Despite this problem, there is a range of effectively working mechanisms that promote exchange of students and researchers (Marie Curie actions, TEMPUS, Erasmus Mundus, Russian initiative on attracting leading scientists etc.).

On the EU side, the objectives for international cooperation, including the cooperation with the Russian Federation, are laid out in the EU Strategy for International Cooperation in Research & Innovation adopted on September 24, 2012. On the Russian side, there are two Federal strategies that provide the framework for S&T cooperation with the EU. In 2011 the Russian government adopted the “Strategy for Innovative Development of the Russian Federation until 2020” and the “Russian State policy for international science and technology cooperation”, adopted on January 2000. These documents set trends in the Russian S&T policy and are in good coherence with the “Europe 2020” strategy, as well as with the EU’s next framework program for research and innovation “Horizon 2020”. Moreover, Russia acknowledging the importance of the green growth and the shift towards bioeconomy adopted the Complex Programme for Biotechnology Development in Russia till 2020 – “BIO 2020”, aimed at Knowledge-Based Bio-Economy formation. Still, discrepancy between the social-oriented EU S&T policy and Russian hi-tech focused S&T policy may slow down the process of programmes’ harmonization.

**Infrastructure and domestic framework conditions**

Recently Russia made a leap forward in the STI infrastructure. In 2009 the so-called Skolkovo project was launched in Russia. The project’s aim is to create a special environment that will concentrate intellectual resources and encourage free creativity and scientific inquiry. The Skolkovo project is open for foreign companies. Moreover, participation of foreign experts is one of the conditions for a project application to be granted a status of Skolkovo Innovation Center Participant by the Skolkovo Fund expert panel. This naturally pushes Russian organisations to search for European partners. Without such a motivation mechanism, there would be no or little interest for joint projects with foreign partners. A tender for Russian and foreign companies is now open and will be held on a permanent basis.

On 1 April, 2011 the Russian government approved a list of 27 priority Technology Platforms, aimed to consolidate stakeholders in the corresponding thematic areas. The implementation of these platforms involves the partnership of government, business and science in the development of advanced technologies and turning them into production. Due to the fact that Russian TPs are on the early stage of formation, nowadays the possibilities of dialogue between Russian and the European TPs are underused but this could bring new perspectives for mutually beneficial collaboration in priority S&T areas.

Russian government also supports the active formation of Innovative technology clusters, including clusters with international participation. In 2012 Russia launched a nationwide cluster program.

Thereby on the one hand there is an increasing coherence of EU and Russian views on S&T&I development. On the other hand a lot of issues still need to be addressed:

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54 [http://www.mid.ru/bdomp/ns-osndoc.nsf/d84a386d3ed00d8e432569fa003a70b5/14e730204ca8d223432569fb004872a5!OpenDocument](http://www.mid.ru/bdomp/ns-osndoc.nsf/d84a386d3ed00d8e432569fa003a70b5/14e730204ca8d223432569fb004872a5!OpenDocument)
Political
- political disagreements, including those on a bilateral level with some MSs, hamper the S&T&I cooperation

Economic
- customs duties and taxes on materials and equipment complicate scientific work and as consequence influence the attractiveness of one or another country for research
- unfavourable investment climate in Russia, especially in Moscow

Regulatory
- a high level of bureaucracy
- different competition rules, timing, evaluation criteria, review and reporting procedures for projects;
- incompatibility of funding schemes, of legal and social welfare systems (e.g. unsettled social insurance, pension funds for scientists working abroad)

Cultural/Social
- language barriers and unfamiliarity of EU scientists with the application procedures in Russia, and vice versa, hamper the full exploitation of cooperation opportunities
- lack of knowledge among the EU scientists about research opportunities in Russia
- difference of managerial styles
- lack of trust for cooperation

Topics for improvement that both sides should work on:
- Improvement of coordination between EU-Russia on both multilateral and bilateral level, using the opportunities for synergies and the existing cooperation mechanisms, knowledge and researcher networks.
- Harmonization of the administrative procedures of RTDI programmes and calls, including the expert evaluation (common acceptance of projects’ selection procedures and criteria).
- The legislative framework for cooperation, including questions of IPR and patent regulation issues needs further approximation.
- Fostering academic and scientific mobility between the EU and Russia by dismantling subjective and objective existing barriers, including visa regime facilitations and clarification of taxation procedures.
- Facilitation of customs procedure for the exchange of project results, including biological samples, materials and equipment for scientific purposes.
5 Results of Structural Foresight

With regard to the structural S&T cooperation, three supporting activities have been developed as part of the foresight dimension of ERANET.RUS: a SWOT analysis with regard to current and future cooperation, a set of structural scenarios for the future cooperation, and a Delphi two round survey among researchers aiming to assess the scenarios and to collect data on critical issues with regard to future cooperation. Each of those three activities and their outcomes are described below.

5.1 SWOT analysis

In the following we present the results of a SWOT analysis of EU MS/AC and Russia cooperation in R&D and innovation. This analysis was performed in the framework of a foresight creativity workshop held at the JRC-IPTS in December 2010. The participants were foresight experts and policy-makers in EU Russia S&T cooperation.

![FIGURE 8: SWOT Analysis]

**STRENGTHS** (Internal strengths to RDI)
- Tradition, History of Cooperation, deep cooperation
- Strong basic research schools in RU in certain fields (e.g. physics, mathematics, space, energy).
- Existing networks of expatriate scientists: RU scientists in EU
- Similar policy objectives (Technology Platforms, etc.)
- Cooperation on large scale infrastructures (XFEL, ITER, CERN, space, etc.)
- Political will to cooperate in R&D – Modernisation partnership
- Cooperation on the level of equals (EU-RU)
- Legal Setting established (Bilateral – 15 out of 27 EU MS, EU-level – S&T agreement)
- Bologna Process – Convergence of educational systems
- Integration in scientific societies in EU of RU scientists & EU level networks (e.g. EEN, ..)
- Cooperation in EU Programmes (FP7, COST, EUREKA, etc.)
- Institutional level cooperation well established (universities, academies, etc.)
- Increases of budgets for cooperation
- Mobility programmes in place (TEMPUS, ERASMUS External Coop. Window)
- Ongoing networking in projects (ERA.Net RUS, etc.)
- Strong R&D capacities in a number of fields (physics, mathematics for basic research; nuclear, space, defence, ICT – for applied research)
- Organisational issues: top-down decision making & political will
- Visible interest from top leaders (e.g. integration with EU visa, etc.)
- Mentality issues – preference for large scale projects
- Large companies – interest in global competitiveness (sensibility to external threats – need to innovate
- Internal threats to national monopolies (survival issues)
- At the level of individuals: more freedom & opportunities; globalisation matters especially for younger people (ICT, internet, contact, language skills); change of mentality; the process goes on (better cooperation; policy instruments
- Existing instruments
- Resources for cooperation are given
- No cultural barriers

**WEAKNESSES**
- Perceived brain drain
- Lack of info-mechanisms
- Service innovation
- Legal/financial framework
- National competitiveness
OPPORTUNITIES

- Similar challenges (energy, safety, climate)
- Global competition
- Increase of RU language knowledge in EU, Vice versa English in RU
- Better exploitation of contacts with expatriate scientists
- Geographical & cultural proximity/diversity
- Russian need for technologies
- Complementarity of goals (space) – joining forces to compete on the world market
- Joining forces in global forums (G8, G20, etc.)
- Membership of RU in international organisations (WTO, OECD, etc.)
- Increases of budgets for cooperation
- Development of ICT technologies – facilitates cooperation (Skype, etc.)
- Dense Economic linkages /cooperation well established
- Increasing wealth
- Global issues pressure (security, etc.)
- Increase mobility (use chances)
- S&T as catalyst for other policies
- Complementarity of basic and applied research
- Critical mass for joint infrastructures
- Advance administration
- Arctic cooperation
- Market penetration
- Human resources in joint education
- Promoting future oriented thinking in research policy making
- Religious cooperation as trigger for S&T
- Participatory methods & wider societal involvement in priority setting
- Regulatory cooperation/pressure – IPR, standards

THREATS/WEAKNESSES

- Competition with global partners
- Language (plus/minus)
- Brain drain (plus/minus)
- Political issue (no decision power)
- Limited view on R&D system (private, informal, etc.)
- Incomplete statistics, classifications, standards,
- Competition in strategic sectors
- Differences in criteria for evaluation (ex-ante)
- No ex-post/impact evaluation
- Global crisis
- Lack of absorptive capacities
- Different cultures in management
- Visas, legal problems
- Budgetary limits
- IPR
- Predominance of public R&D, theoretical focus
- Law enforcement in Russia
- Low EU funds for private sectors
- Entrepreneurship: culture, lack of linkages
- Transfer of funds
- Lack of knowledge about private sector
- R&D centres less accessible (e.g. than in US)
- Lack of experience in participation in projects/programmes
- Lack of openness of funding of Russian R&D
- Problem orientation versus sector orientation
- More competition with EU member states in R&D with same budget
- Collaboration at all levels (e.g. Technological level of sectors)
5.2 Structural scenarios

Through desk research and a series of workshops, 4 different scenarios have been developed. Each scenario is composed of a snapshot of what S&T cooperation between the EU (and its Member States and Associated Countries) and Russia could look like in 2020, as well as a roadmap explaining the events and milestones that could take place for the snapshot to materialise.

The graph below presents the 4 snapshots, using 4 dimensions as explained in chapter 2 of this report:

- S&T policy integration vs. disintegration
- Low vs. high R&D investment
- Private vs. public investment
- High vs. low performance

Each scenario is further explained and illustrated below, including a story describing each snapshot, scores on impact variables, and a roadmap with events and milestones that may occur in order for the snapshot to materialise (for the detailed scenarios see the annex).
FIGURE 10: Scenario 1 - R&D policy paradise

The year 2020 is coming to an end in a few days, and we look back at a decade of prosperous cooperation in Research, Development and Innovation (RDI) between the EU and Russia. Russia’s participation as an associated country in the EU’s Horizon 2020 programme has proven an unexpected huge success. The presidents, both of the EU and Russia have gathered in Moscow to celebrate the achievements and sign the association agreements for the next programming period, to the EU’s new funding tool, Innovation for the Future 2030.

Framework conditions
- Political will on both sides to strengthen cooperation has been translated into enhanced framework conditions for RDI cooperation and joint stimulation instruments
- Russia is member of the WTO & OECD

Governance and institutional solutions
- Free-trade Zone with EU agreed and implemented
- Modernisation partnership evolves into innovation partnership with related funding instruments and/or cooperation among funding bodies
- Joint management committees in place to provide good regulation for the cooperation and to manage the day to day work

S&T cooperation instruments
- Horizon 2020 FP9 association and participation in other EU funding programmes for R&D and innovation will take place, support network for Horizon 2020 participation in RU established, RU participation in JTIs and JP

<table>
<thead>
<tr>
<th>Impact Variables (+ vs -)</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. S&amp;T policy integration</td>
<td>+</td>
</tr>
<tr>
<td>2. R&amp;D Investment (high vs low)</td>
<td>+</td>
</tr>
<tr>
<td>3. Performance (high vs low)</td>
<td>+</td>
</tr>
<tr>
<td>4. Private involvement</td>
<td>+</td>
</tr>
<tr>
<td>5. Transparent governance (advanced vs old fashioned)</td>
<td>+</td>
</tr>
<tr>
<td>6. Economic development</td>
<td>++</td>
</tr>
<tr>
<td>7. Cultural proximity</td>
<td>+</td>
</tr>
<tr>
<td>8. Thematic diversity (wide vs narrow)</td>
<td>+</td>
</tr>
<tr>
<td>9. S&amp;T cooperation instruments (innovative vs traditional)</td>
<td>+</td>
</tr>
<tr>
<td>10. Qualified Human Resources</td>
<td>+</td>
</tr>
<tr>
<td>11. Regulatory framework</td>
<td>+</td>
</tr>
<tr>
<td>12. Research infrastructure/equipment</td>
<td>+</td>
</tr>
</tbody>
</table>

- Russian R&D and innovation funding instruments open to EU participation and funding allocation simplified (e.g. public procurement abolished for R&D and innovation funding)
- Joint EU-Russian RDI Fund established and operational

Public versus private actors in S&T
- Public-Private Partnerships in selected areas (aeronautics, gas transportation, etc.)
- A reasonable number of R&D intensive companies in Russia are performing R&D and compete with EU companies
- The Russian S&T system in a transformation phase from publicly dominated to a more significant role of the private sector
- Significantly higher investment in R&D and innovation by Russian companies

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Empty Cooperation Programming Shell

The EU and Russia have come closer culturally. Among university students Russia has become a popular destination for exchanges. In spite of a strong will for S&T cooperation, Russia is still lagging behind its RD cooperation potential with the EU and has been considered as Third Country towards the EU’s Horizon 2020 programme. A number of policies have been put in place, which however are empty boxes as they lack effective instruments. They are declarations of good intentions without adequate budgets or adequate implementation plans. New hope comes from ongoing negotiations on the participation of Russia in the EU’s Horizon 2020 follow-up RD funding programme.

Cultural Similarities and differences

- Russia and EU are closer culturally (cinema, music, tourism)
- However strong divergence in managerial styles (both in the public and private sector)
- Such divergence requires more bureaucracy as it undermines trust
- “Publish or perish” concept and PR for research outweighs scientific importance

Public sector cooperation – reading between the lines

- Mismatch of thematic areas: Humanities, ecology, law
- The public sector fails to catch new leaps in technology
- The public sector is the only actor that supports fundamental R&D in times of economic downturn
- Many programmes, initiatives etc., but the vast majority of them remain only at formal level.

<table>
<thead>
<tr>
<th>Impact Variables (+ vs -)</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. S&amp;T policy integration</td>
<td></td>
</tr>
<tr>
<td>2. R&amp;D Investment (high vs low)</td>
<td></td>
</tr>
<tr>
<td>3. Performance (high vs low)</td>
<td></td>
</tr>
<tr>
<td>4. Private involvement</td>
<td></td>
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<tr>
<td>5. Transparent governance (advanced vs old fashioned)</td>
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<tr>
<td>6. Economic development</td>
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<td>7. Cultural proximity</td>
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<td>8. Thematic diversity (wide vs narrow)</td>
<td></td>
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<tr>
<td>9. S&amp;T cooperation instruments (innovative vs traditional)</td>
<td></td>
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<tr>
<td>10. Qualified Human Resources</td>
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<tr>
<td>11. Regulatory framework</td>
<td></td>
</tr>
<tr>
<td>12. Research infrastructure/equipment</td>
<td></td>
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</tbody>
</table>

Infrastructure

- Continuous investments in common-used infrastructure as legacy of previous initiatives

Governance, Regulation, Standards

- De facto separation between the core and periphery EU countries
- Undercover conflicts within the EU on different economic and political issues
- Visa regime between EU and Russia remains in place, despite long negotiations. Actually it is the EU that adds new barriers to the process.
- Local “wars of standards” in aviation, space, biotechnology, nanotechnology and in next wave of it.
- Open-source and imitation challenge the global IPR. It exists only in certain “well-legislated” areas such as the EU.

Empty Cooperation Programming Shell

- Decreased R&D investment, and overall decrease in research efficiency
- Public involvement in research infrastructure coupled with very fragmented R&D
- Lack of qualified personnel, brain drain from public to private sector
- Widened and unutilized need for new initiatives
- No match of EU and Russian research priorities
- EU-RU cooperation initiatives fail, visa regime remains in place, EU adds new barriers to RD cooperation

<table>
<thead>
<tr>
<th>Year</th>
<th>Policy</th>
<th>Scientific</th>
<th>Political</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- No incentives for private participation in RD cooperation, weak thematic focus & non-adequate infrastructure
- Widened network of public investment in RD
- Private RD moving from products to complex services
- No traceability of EU enlargement
- Global economic crisis peaks
- Collapse of the state-centric system of international relationships
- Rise of BRICS
FIGURE 12: Scenario 3 - Isolated R&D Excellence

Scenario: Isolated R&D Excellence

The world economy is becoming multi-polar, lifting the Asian economic pole which now produces ~40% of world output. Economic globalisation is accompanied, perhaps surprisingly, by scientific isolation. Every continent is trying to build up the best Ivory Towers to reach highest S&T performances in their specialties and remain competitive. Collaboration is limited to specific areas.

Globalisation: multi-polar global economy
- China and India are big economic super-powers
- Fast rise of Japan, Korea, Malaysia, Indonesia
- South Asia alone produces 44% of world wealth
- Asian competition has increasingly extended to the high-end products and services of the value chain

Ivy towers: the scientific community is fairly isolated within national (EURF) borders
- Concentration on national S&T priority areas: increase in R&D investment, which is very targeted to national (or EU) priorities.
- Low mobility of scientists, they are needed at home
- Only occasional international collaboration where mutual benefits are expected
- Either project level collaboration with a public-private cooperation or highly regulated public agreement

### Impact Variables (+ vs -)

- 1. S&T policy integration +
- 2. R&D investment (high vs low) +
- 3. Performance (high vs low) +
- 4. Private involvement +
- 5. Transparent governance (advanced vs old fashioned) +
- 6. Economic development +
- 7. Cultural proximity -
- 8. Thematic diversity (wide vs narrow) -
- 9. S&T cooperation instruments (innovative vs traditional) -
- 10. Qualified Human Resources +
- 11. Regulatory framework +
- 12. Research infrastructure/equipment +

### Thematic priorities
- Nuclear fission and defense in Russia
- Green energy in Europe
- Market driven research in nanotechnologies or IT

### Cultural differences
- Different management styles and lack of policy integration risk to jeopardize the (few) collaborative projects
- Legal issues and IPR discussions as additional risks
- Russia tries to keep (geopolitically) the balance between EU and other world powers

Ivy towers - Isolated R&D excellence

2012 OECD & EU Technology for growth poicy package
2013 Fusion R&D programme excellence for economic development
2014 ENP - FP programmes SMART, Nanosciences Science programme focus on national priorities
2016 EU - New Stability & Growthpoint Fiscal Integration
2017 EU Science for Excellence Groups, First Chinese RFM Excellent
2019 First Indian World Bank President, China joins the OECD

Europe is committed by national units, to keep balance between EU and other rising powers.

Use of renewable energy.
FIGURE 13: Scenario 4 - Same problems – reORIENTation

Ten years ago, in 2010, there were hopes for Russia’s full scale integration into the European RTD Framework Programme (then FP7). However – despite of numerous discussions and a lot of preparatory work – an official agreement had not been signed and now. In 2020, Russia is still in a position of a third country. This is the last year of the EU’s “Horizon 2020” programme and Russia has not yet been fully integrated in the European Research and Innovation Area. However, the interest for enhancing EU-Russia RDI cooperation is still rather high despite of Russia’s R&D connections with China and other East countries, and there is a hope that a new stage of RDI interactions between Russia and the EU starting in coming years will be more effective and fruitful.

Framework conditions
- Shifting Russia’s S&T cooperation efforts towards the Eurasian Union because of limited enthusiasm of the EU to strengthen cooperation
- Advancement of the EU as a military power slows down EU-Russia S&T cooperation because of the growing security impact of dual use technologies
- Governance and institutional solutions
  - IPR policy in Russia is still being unsettled
  - Agreement on the facilitation of scientific visa procedures has not been reached
  - Convergence of standards (Bologna process, etc.) is superficial and does not lead to significant improvements
  - Incompatibility of funding schemes, of legal and social welfare systems (e.g. unsettled social insurance, pension funds for scientists working abroad)

Impact Variables (+ vs -) Scores
1. S&T policy integration -
2. R&D investment (high vs low) -
3. Performance (high vs low) + -
4. Private involvement -
5. Transparent governance (advanced vs old fashioned) -
6. Economic development -
7. Cultural proximity -
8. Thematic diversity (wide vs narrow) -
9. S&T cooperation instruments (innovative vs traditional) -
10. Qualified Human Resources -
11. Regulatory framework -
12. Research infrastructure/equipment -

S&T cooperation instruments
- Instruments of financial support to scientific and innovative activities are outdated and very inefficient
- HRST programmes between EU and Russia shrinking
- Discrepancy between the social-oriented EU S&T policy and Russian hi-tech-focused S&T policy

Public versus private actors in S&T
- Minor integration between public and private sectors. Russian public sector isn’t open for collaboration with foreign private companies
- Low return on investment prevents EU MS/AC companies to invest in Russian R&D sector
- EU companies’ expectations of benefits from S&T cooperation tend downwards
- Innovation activity of Russian enterprises is declining, followed by decreasing in BERD
- Russia strongly protects its national businesses

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Table: Same problems, reORIENTation

<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Russia is a member of Euratom Association</td>
</tr>
<tr>
<td>2012</td>
<td>Russia joins OECD</td>
</tr>
<tr>
<td>2014</td>
<td>Agreement with foreign companies program</td>
</tr>
<tr>
<td>2017</td>
<td>Agreement with foreign companies program</td>
</tr>
<tr>
<td>2020</td>
<td>New Russian participation becoming more intense</td>
</tr>
</tbody>
</table>

New wave of world clubs
- Highly noticeable increase in the number of Russian universities joining major R&D clusters in Europe
5.3 **Delphi results on structural elements**

The ERA.Net RUS survey was devoted to the identification of key future trends in the cooperation in research, development and innovation (RDI) between Russia, the European Union (EU), its member states (MS) and the associated countries (AC) to the EU’s 7th Framework Programme for RTD (FP7).

### 5.3.1 Likelihood of EU-Russia RDI cooperation scenarios

The DELPHI questionnaire included four scenarios of RDI cooperation between Russia and EU MS/AC in the time perspective up to 2020. Scenario 1 R&D policy paradise was the most optimistic regarding RDI cooperation intensity and more than 95% of respondents considered it as rather or very desirable. However, more than two thirds of respondents thought it as rather or very unlikely to happen.

**FIGURE 14: Probability and desirability of Scenario 1**

For the less optimistic scenarios we can observe similar response patterns: more than 60% of respondents considered these scenarios as rather or very likely to happen, however more than 84% and up to 90% of respondents considered these scenarios as rather not or very undesirable. Therefore the scenario 1, being the most desirable but rather unlikely, can be considered as a “goal scenario” to be targeted by the EU and Russia.

### 5.3.2 Framework conditions for EU-Russia RDI cooperation

Increasing R&D investment is the key issue for EU-Russia RDI cooperation (684 respondents). Many experts also underlined the importance of availability of financial
instruments to support S&T cooperation (499 respondents), as well as training and education of highly qualified RDI personnel (478 respondents).

**FIGURE 15: Ranking framework conditions**

On several issues, Russian respondents were more sceptic than EU respondents:

- **R&D investment**: the probability of an increase in gross expenditure on R&D (GERD) in the EU until 2020 was assessed by EU experts with a slight majority of 55% as rather or very likely. As for a GERD increase in Russia EU experts were more optimistic and 71% supposed it as rather or very likely. Russian respondents, however, assumed it with 58% as rather or very unlikely. But they do consider adequate investments as a key factor for the Russian RDI sphere to be able to compete.

- **Private sector cooperation**: two thirds of EU respondents thought that an intensification of business sector cooperation between the EU and Russia is likely or very likely. Some EU respondents see the involvement of businesses in RDI cooperation as the most important topic. Respondents to the Russian questionnaire show the opposite trend with 70% classifying it as rather or very unlikely. However, from Russian experts it was noted that research groups are quite interested in such cooperation. One of the arguments for business involvement indicated in the survey is the low awareness of government policy of real needs and requirements of the Russian RDI sphere.

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55 Two questionnaires were used for the survey. An English one was addressed to experts situated in the EU MS/AC; this target group included a limited number of Russian experts, who reside permanently or temporarily in the EU MS/AC or Russia. The respondents to the English questionnaire were named in the analysis EU respondents. A second nearly identical questionnaire in Russian was addressed to Russian experts situated in Russia. In the analysis this group was named Russian respondents.
• Human resources: the probability of an improvement in RDI cooperation as a result of a convergence of the educational systems was assessed as rather or very likely by 63% of EU experts. In contrast, nearly 70% of RU experts considered it as rather or very unlikely.

• An improvement of RDI-related education in the EU was expected by more than two thirds (67.6%) of EU experts. They were less certain about the perspectives in Russia, but still 61.5% rated an improvement as rather or very likely. However, more than 80% of Russian respondents supposed that education would rather or very unlikely be improved in Russia. Russian experts consider training and education of highly qualified RDI personnel as one of the high-priority factors, due a very acute shortage of skilled personnel created by brain drain and young people’s lack of interest in research careers.

• Opinions about an increase in researchers’ mobility from the EU to Russia were also very different. More than half of EU experts said it would increase (very or rather likely), while 90% of Russian respondents were sceptical about this (very or rather unlikely).

• Most of EU respondents estimated a shortage of qualified R&D personnel in the EU as very likely (25%) or rather likely (40%). For Russia their expectations were even more significant: very likely (32%) or rather likely (40%). The Russian experts were still more pessimistic about the situation in their country: 90% expected a shortage as very or rather likely.

• Research infrastructure: Respondents were more sceptical about research infrastructure in Russia than in the EU: roughly two thirds of respondents evaluated
the potential of a deterioration of research infrastructure in Russia as rather or very likely. However, Russian experts do consider investment in research infrastructure and equipment a key factor for developing the Russian RDI sphere adequately.

- **An alignment of thematic priorities** between the EU and Russia was assessed by EU experts with 57% as rather or very likely, while 60% of Russian experts considered it as rather or very unlikely. Among Russian respondents, avoiding the development of only trendy areas (mainly connected with mining energy resources) but focusing on diversity was seen as an important factor determining the future of the Russian RDI sphere and subsequently for developing cooperation with the EU.

Apart from these quantitative results, specific framework conditions came up in the open questions.

- With regard to finding **solutions through policy dialogue** to the existing obstacles, EU experts mentioned addressing the visa regime, bureaucracy on EU side and corruption with funds’ allocation on the Russian side, intellectual property, customs issues. Russian experts mentioned a favourable visa regime and simplified customs regulations as important issues.
- **Availability of instruments for supporting the S&T cooperation**: for most of European respondents sustainable funding of the collaborative projects is very important (also funding of the follow-up projects). Allocation of the sufficient funding resources should be crucial on both sides, in EU and in Russia. For the Russian experts, apart from funding for international projects, investments should be encouraged into Russian projects which require reliable and transparent tools.
- Some EU respondents see the current **weakness of the world economy** multiplied by human factor and poor intellectual property models as the basic obstacle both in EU-Russia R&D cooperation and in R&D development of individual countries in the next years.
- With regard to S&T policy integration between Russia and the EU, about one third of the Russian respondents believes that before starting any sort of integration, the focus should be on **building a strong foundation for the own system**.

### 5.3.3 General assessment EU-Russia RDI cooperation perspectives

Both the EU and Russian respondents supposed that the idea of RDI cooperation between the EU and Russia would be very or rather strongly supported by the scientific community in their countries (68% and 81% respectively). The opinion of the respondents about the policy makers’ support of RDI cooperation was different. While about half of EU experts expected that EU-Russia RDI cooperation would be weakly or very weakly supported (53%) by policy makers, 80% of Russian respondents voted for weakly or very weakly supported.

As a conclusion from the former sections a series of barriers can be identified with regard to increased EU-Russia cooperation as shown in the figure below.
FIGURE 18: Barriers to increased EU–Russia S&T Cooperation

<table>
<thead>
<tr>
<th>Barriers to increased EU-Russia S&amp;T Cooperation</th>
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</thead>
<tbody>
<tr>
<td>Political will on both sides</td>
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<tr>
<td>Lack of support for exchanges and mobility of researchers</td>
</tr>
<tr>
<td>Bureaucracy from the EU side and corruption from the Russian side</td>
</tr>
<tr>
<td>Mismatch between the levels of the RDI sphere of Russia and the EU, due to a poor education policy (according to Russian respondents)</td>
</tr>
<tr>
<td>Insufficient investments hindering the development of the RDI sphere in Russia</td>
</tr>
<tr>
<td>Low salaries of researchers in Russia</td>
</tr>
<tr>
<td>Visa procedures, IPRs and to a lower extent customs barriers (preventing free movement of equipment)</td>
</tr>
<tr>
<td>Lack of sustainable funding for research cooperation (e.g. joint fund, INTAS like instrument)</td>
</tr>
<tr>
<td>Low probability of increased businesses involvement in RDI cooperation (from Russian perspective)</td>
</tr>
<tr>
<td>Lack of priority areas for research (Russian respondents)</td>
</tr>
</tbody>
</table>
6 Results of thematic foresight

An important dimension of a future increased S&T collaboration between EU and Russia includes the identification and implementation of thematic priorities for collaboration. In 2011 a first report was prepared on the thematic S&T priorities for the European Union and the Russian Federation, focusing on a meta-analysis of thematic priorities in 2020. Based on bilateral discussions between the ERA.Net RUS Plus funding organisations, the following four broad scientific priorities were selected for their upcoming call on S&T projects in 2014: Nanotechnologies, Environment/Climate Change, Health, and Social Sciences and Humanities (SSH). For each of the priority areas, a thematic roadmapping workshop has been organised in spring 2013 (22 and 23 April in Brussels, and 16 and 17 May in Moscow), which have resulted in a set of more specific topics for future collaboration. These workshops will serve a double purpose: 1. highlighting topics for future RDI cooperation between the EU and Russia in each thematic area, and 2. selecting specific call topics for the ERA.Net RUS Plus S&T call in a transparent and structured way. Below the results are presented from the meta analysis, as well as from the thematic aspects of the Delphi survey and from the thematic roadmapping workshops with experts from funding organisations. In a final section options for the implementation of the thematic priorities are considered.

6.1 Meta–analysis of foresight studies at EU level, in EU MS and Russia

In 2011, the ERA.Net RUS foresight partners performed a meta-analysis of thematic S&T priorities in the EU and Russia. Foresight studies in EU member states, at the EU level and in Russia were analysed for this purpose and a report drafted. We present here the visualization of this comparison.

In the following words cloud on the future EU thematic S&T priorities, greater prominence is given to (the highlighted) words that appear more frequently in the EU foresight studies.

FIGURE 19: Future EU thematic S&T priorities

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56 Figure created with [http://www.wordle.net/](http://www.wordle.net/) on 20/04/2011
In the following word cloud on the future **Russian thematic S&T priorities** greater prominence is given to (the highlighted) words that appear more frequently in the Russian foresight studies.

**FIGURE 20: Future Russian thematic S&T priorities**

![Word cloud showing future Russian thematic S&T priorities](image)

By cross-checking the EU thematic S&T priorities with the priorities of the Russian Federation, the common denominators can be identified:

**FIGURE 21: Cross-checking of the EU thematic S&T priorities and the priorities of the Russian Federation**

<table>
<thead>
<tr>
<th>EU thematic S&amp;T priorities</th>
<th>Russian thematic S&amp;T priorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>energy, transport, health, nanotechnology</td>
<td>environment, life systems and nature management, information and telecommunication systems</td>
</tr>
</tbody>
</table>

The comparison of the word clouds indicates that the EU- Russian Scientific and Technological Cooperation Roadmap is on the track especially with S&T programmes in the fields of **energy, transport, health, nanotechnology**. Besides, it is worth mentioning that both reviews revealed that a strong focus lies on the **technological implementation** (including **biotechnology**). While the EU emphasizes thematic fields supporting a sustainable development, i.e. food, water and energy security, climate change, the Russian Federation calls apart from the similar topics environment, life systems and nature management also for **information and telecommunication systems**. Socio-economic areas and humanities are clearly underrepresented apart from **ageing and population** in the EU.

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57 Figure created with [http://www.wordle.net/](http://www.wordle.net/) on 20/04/2011
6.2 Thematic roadmapping workshops

6.2.1 Methodological approach

As input for the thematic roadmapping workshops the following elements contributed:

- A Delphi survey of relevant topics among researchers in both the EU (MSs and ACs) and Russia (see chapter 2).
- The development of generic thematic roadmaps for each thematic priority (see chapter 3).
- A background document based on all the above data collected.

Each thematic roadmapping workshop gathered around 10 experts from national funding organisations. Participants were researchers or other experts in the thematic priorities defined for the ERA.Net RUS Plus S&T Call: Nanotechnologies, Environment/Climate Change, Health, SSH.

The participants in the workshops were nominated by the members of the ERA.Net RUS Plus Group of Funding Parties. In the nomination procedure, the possible composition of the future Scientific Council of the ERA.Net RUS Plus project was considered.

The workshops were organised and facilitated by foresight experts of the partners involved in the ERA.Net RUS foresight exercise: the Centre for Social Innovation (ZSI, Austria), the Institute of Prospective Technological Studies (JRC-IPTS, Seville), the Higher School of Economics (HSE, Moscow) and the International Centre for Innovations in Science, Technology and Innovations (ICISTE). The proposed topics for the ERA.Net RUS Plus S&T call will be presented to the final ERA.Net RUS conference (June/July 2013 in Istanbul) and the Group of Funding Parties. The topics will then formally be approved at the kick-off meeting of the ERA.Net RUS Plus project in November 2013.

The workshops followed a four step approach:

- **Step 1:** Introduction to the roadmapping workshop by workshop organisers. Short presentation of the background document, the Delphi results, the topics selected under the first joint call, and the draft roadmap.
- **Step 2:** Detailed discussion of the different elements of the roadmap, in order to correct, change, regroup, complete or delete specific parts of it. This step is crucial in creating a joint understanding of the important issues. Participants were also offered the possibility to add new topics to the roadmap that they felt were missing.
- **Step 3:** A two-round voting for both general (round 1) and more specific (round 2) research topics. Selection and voting procedures on the collected topics. This steps leads to a priority list of preferred topics for EU-Russia collaboration.
- **Step 4:** Elaboration and formulation of each of the topics of the priority list, so as to create an agreement and joint understanding of the way the topics are formulated. For each topic a participant agreed to elaborate a more detailed description after the workshop, to be commented by the other participants, in order to make the topics more concrete and understandable.

Each workshop lasted for approximately six hours, and included an informal dinner the evening beforehand in order for participants to get to know each other. After the workshops
the final results have been communicated to the ERA.Net RUS Plus Group of Funding Parties as well as to the appropriate policy makers and stakeholders at national and EU level.

The workshops also consisted an interesting experience in supporting priority setting in a multi-level (European/transnational, national) and multilateral (MSs, ACs, Russia) policy context. Research programming collaboration in such a multi-layered context is complex and poses many challenges in aligning interests of diverse stakeholders. The ERA.Net RUS project and in particular the foresight elements constitute an interesting and ground-breaking case to further advance the understanding of research programming in such a complex landscape.

6.2.2 DELPHI results

The overall DELPHI survey, conducted by the ERA.Net RUS foresight partners, was devoted to the identification of key future trends in the cooperation in research, development and innovation (RDI) between Russia, the European Union (EU), its member states (MS) and the associated countries (AC) to the EU’s 7th Framework Programme for RTD (FP7). The survey was conducted in two rounds. The first round of DELPHI was focused on the identification of scenarios and framework conditions of RDI cooperation between Russia and EU MS/AC in the time perspective up to 2020. This first round was complemented by the detection of social challenges and thematic fields of the EU–Russian RDI cooperation in the second round. Moreover during the second round the several issues regarding the framework conditions for the EU–Russia RDI cooperation were specified (cost categories, which should in particular be increased; mobility of researchers; intellectual property).

The overall sample of experts (4408 from EU MS/AC and 2287 from Russia) invited to fill in the DELPHI questionnaire was similar in both rounds. The survey questionnaire was developed both in Russian and English languages  

The thematic part of the Delphi survey has combined two data sources:

- For the societal challenges, the nomenclature proposed as part of the draft Horizon 2020 proposal of the European Union was used, up to the most detailed level available in the nomenclature: 6 societal challenges (at the time of the proposal, later on between the Delphi and the workshop the number has changed into 7 challenges) with each up to 2 sublevels.
- For the research areas a Russian nomenclature was used for each of the 4 thematic areas, with each up to 2 sublevels, drawing on several studies from the Higher School of Economics.

Below you can find the survey results for the broad categories of societal challenges and research areas.

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58 Further on relevant questionnaires are referred to as “the Russian questionnaire” and “the English questionnaire” respectively.
Among the societal challenges for the EU-Russia RDI cooperation (see figure 1) the most important ones according to experts were the following:

- Health, demographic change and wellbeing (55.19% — the Russian questionnaire; 45.12% — the English questionnaire).
- Secure, clean and efficient energy (20.02% — the Russian questionnaire; 25.46% — the English questionnaire).
- Climate action, resource efficiency and raw materials (10.85% — the Russian questionnaire; 13.80% — the English questionnaire).

When looking at the thematic fields at the most general level, the distribution of answers made by Russian and European respondents was surprisingly next to fully coincided. Around 40% of Russian and European experts agreed that the most perspective field of cooperation is...
“New materials and nanotechnologies”; “Medicine and health” was on the second place (more than 25% of respondents).

Delphi results on the second and third level for both the societal challenges and the thematic areas can be found in annex of this report. For illustration purposes we show below the results for social issues at the second level and within the social issues for 'development of human capital' at the third level.

FIGURE 24: Promising thematic areas of the EU-Russia RDI cooperation in the field “Social issues”

TABLE 1: Distribution of responses by subareas for the area “Development of human capital” (field “Social issues”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of staff training, of upgrading and lifelong learning systems in the context of global S&amp;T trends</td>
<td>15</td>
<td>Potential demand for and supply of personnel and skills</td>
<td>11</td>
</tr>
<tr>
<td>Global migration flows, and their forecasts until 2050</td>
<td>5</td>
<td>Development of staff training, of upgrading and lifelong learning systems in the context of global S&amp;T trends</td>
<td>9</td>
</tr>
<tr>
<td>Potential demand for and supply of personnel and skills</td>
<td>4</td>
<td>Global migration flows, and their forecasts until 2050</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
<td><strong>Total</strong></td>
<td><strong>28</strong></td>
</tr>
</tbody>
</table>
6.2.3 Thematic roadmaps by thematic areas

The thematic roadmaps for each thematic area were constructed using the nomenclature of societal challenges of the EU and the nomenclature of research areas of Russia as a starting point. Those were then combined in one single roadmap, connecting them together. In the initial roadmaps that were developed, a high level of detail was included, but this appeared to be less useful for the workshop discussions.

An overview of all roadmaps is shown in annex. Below for illustration the first part of the roadmap for Social Science and Humanities is presented, which was discussed at the first of four workshops.

FIGURE 25: SSH Roadmap – Societal challenge one to five
### 6.2.4 Outcomes of the thematic roadmapping workshops

The tangible outcomes of the four thematic workshops include the following elements:

- Three topics selected for the joint call under ERA.Net RUS Plus (see table 2)
- Additional topics for future S&T collaboration (see table 2)
- A detailed description for each of the above (see annex)

Table 2 below presents an overview of all topics identified at the thematic roadmapping workshops for each thematic area. For SSH only topics for the joint call ERANET RUS Plus were identified.

#### TABLE 2: Topics for S&T cooperation between EU MSs/ACs and Russia by thematic area

<table>
<thead>
<tr>
<th>Topics for S&amp;T cooperation between EU MSs/ACs and Russia by thematic area</th>
<th>Health</th>
<th>Nano</th>
<th>SSH</th>
<th>Environment and climate change</th>
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</thead>
<tbody>
<tr>
<td><strong>Three topics selected for the joint call of ERA.Net RUS Plus</strong></td>
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<tr>
<td>1. Molecular Mechanisms of Brain Function and Pathology</td>
<td>1. Advanced nanosensors for Environment and Health</td>
<td>1. Understanding Conflict, Identity, and Memory: Past and Present</td>
<td>1. Increasing the reliability of regional climate projections: models and measurement</td>
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<tr>
<td>2. Regenerative Medicine and Biomaterials</td>
<td>2. Novel functional nanomaterials based on design and modelling</td>
<td>2. Demographic Change, Migration and Migrants</td>
<td>2. Environmental impact and risk of raw materials extraction and transportation</td>
<td></td>
</tr>
</tbody>
</table>

| **Additional topics for future S&T collaboration** | | | | |
| 5. 3D Medicine, Virtual Surgery | 5. Diagnostics: Metrology at the Nanoscale | 5. The relevance of archives for SSH research | 5. Prevention and remediation of pollution of aquatic systems |
| | 7. Nanomaterials and technologies for memory devices | | 7. Impact of transport/traffic on climate change and pollution |
| | 8. Interdisciplinary of nanotechnologies | | |

As an illustration, in the box below the description for the first health topic is presented.
Detailed description of the first call topic in the area of health:
'Molecular Mechanisms of Brain Function and Pathology'

Brain research is focused on investigation of brain function in normal and pathological stay of the organism. It may comprise functional imaging of different brain zones, elaboration of new approaches how to investigate cognitive functionality and stimulate signalling processes. The animal models of mental, neurodegenerative and neuronal inflammation may be regarded here. Application of these data for human are stimulated. Stroke and post-traumatic effects, epilepsy research are appreciated. New approaches to drug discovery and delivery in brain neuronal diseases including primary carcinogenesis and metastasis are welcomed.
6.3 Implementation of the priorities proposed

The thematic priorities identified as a result of the foresight process described above can be implemented through various instruments, both existing ones and possible future instruments to be developed. Among those, the following instruments are being considered:

- The thematic outcomes will be proposed at the first meeting of the ERA.Net RUS Plus project, in order to approve the call topics for the joint call under this project. To this end, the final results of the workshops have been communicated to the ERA.Net RUS Plus Group of Funding Parties.
- The outcomes have also been communicated to the appropriate policy makers and stakeholders at EU level, as input to Horizon 2020 and possible other funding instruments.
- Also currently ongoing or recent initiatives at EU level can be considered where Russia is not yet involved as a partner. See below for an overview of possibilities.
- The results will also serve any other possible future ways of S&T collaboration between EU and Russia in the short and medium term.

The results will also be presented at the Istanbul conference of ERA.Net RUS on 11 - 12 July 2013.

Below an overview is presented by thematic area of current ERA initiatives that can be of relevance to the priorities identified in the thematic foresight.

6.3.1 Current initiatives in the area of health

The table below presents the currently ongoing (research and innovation) initiatives in the area of health. From those ERA initiative in health, the following are closely related to priority areas between EU and Russia as identified in the thematic workshops:

- In relation to brain functioning: Neuron II ERA-NET, JPI Neurodegenerative disease research.
- In relation to cancer: EUROCOURSE (Europe against Cancer: Optimisation of the Use of Registries for Scientific Excellence in research).
- In relation to infectious diseases: INFECT-ERA (Coordination of European funding for infectious diseases research) (Not in the table).
- In relation to cancer and translational medicine: TRANSCAN (ERA-NET on Translational Cancer Research).
- With regard to drug discovery: EURANID (European Research Area Network on Illicit Drugs - Towards integrated European research in illicit drugs).
- Future involvement of Russia in some of those initiatives can be one way of implementing the priority areas for S&T collaboration between EU and Russia.
### TABLE 3: Current ERA initiatives in the area of health

<table>
<thead>
<tr>
<th>ERA-NET</th>
<th>ERA-NET +</th>
<th>ART. 185</th>
<th>ETP</th>
<th>JTI</th>
<th>EUREKA</th>
<th>JPI</th>
<th>PPP</th>
<th>EIT - KICS</th>
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<tbody>
<tr>
<td>emida</td>
<td>erasybio+</td>
<td>edctp</td>
<td>nanomedicine</td>
<td>imi</td>
<td>antimicrobial resistance</td>
<td>innovation for healthy living and active ageing (2014ff)</td>
<td>active and healthy ageing</td>
<td>hbt-ps</td>
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<td>era-age</td>
<td>emrp</td>
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<td>a healthy diet for healthy living</td>
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<td>guardian angels</td>
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</table>

59 Source: ERALEARN

### 6.3.2 Current initiatives in the area of nanotechnology

The table below presents the currently ongoing (research and innovation) initiatives in the area of nanotechnology and materials. Recent ERA networks in nanotechnology are however not very much related to the priority areas between EU and Russia as identified in the thematic workshops.

### TABLE 4: Current ERA initiatives in the area of nanotechnology and materials

<table>
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<tr>
<th>ERA-NET</th>
<th>ERA-NET +</th>
<th>ART. 185</th>
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<th>JTI</th>
<th>EUREKA</th>
<th>JPI</th>
<th>PPP</th>
<th>EIT - KICS</th>
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<th>FET - FLAGSHIP</th>
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<td>aertos</td>
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<td>emrp</td>
<td>nanomedicine</td>
<td>catrene</td>
<td>raw materials (2014ff)</td>
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<td>graphene</td>
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</tbody>
</table>

60 Source: ERALEARN
6.3.3 Current initiatives in the area of Social Sciences and Humanities (SSH)

The table below presents the currently ongoing (research and innovation) initiatives in the area of SSH. Recent ERA networks in SSH closely related to priority areas between EU and Russia as identified in the thematic workshops:

- In relation to demographic change: JPI Urban Europe and EIP Smart Cities
- In relation to regional development and social cohesion: Ruragri
- In relation to relevance of archives for SSH research: Cultural Heritage ERANET+ (Not in the table) and JPI Cultural Heritage (Not in the table)

Future involvement of Russia in some of those initiatives can be one way of implementing the priority areas for S&T collaboration between EU and Russia.

**TABLE 5: Current ERA initiatives in the area of Social Sciences and Humanities**

<table>
<thead>
<tr>
<th>ERA-NET</th>
<th>ERA-NET + ART.</th>
<th>ETP</th>
<th>JTI</th>
<th>EUREKA</th>
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<th>EIT - KICS</th>
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</tbody>
</table>

6.3.4 Current initiatives in the area of environment

The table below presents the currently ongoing (research and innovation) initiatives in the area of environment. Recent ERA networks in environment and climate change closely related to priority areas between EU and Russia as identified in the thematic workshops:

- In relation to climate impact on ecosystems: BIODIVERSA2 (Cooperation and shared strategies for biodiversity research programmes in Europe); CIRCLE-2 (Climate Impact Research and Response Coordination for a Larger Europe - Science meets Policy); ERA-ARD-II (The Agricultural Research for Development Dimension of the European Research Area) (Not in the table); climate KIC; JPI Climate Clik'eu
- In relation to extreme climate events: CRUE ERA-NET (on flooding); JPI Cultural Heritage;
- On prevention and remediation of pollution of aquatic systems: JPI healthy and productive seas and oceans; JPI Water challenges; Acqueau (EUREKA Cluster dedicated to environmental and water related technologies); Seas-ERA; EIP Water Efficient Europe
- In relation to environmental impact and risk of raw materials extraction and transportation: ERA-MIN (Network on the Industrial Handling of Raw Materials for European Industries)
- On climate and pollution in big cities: JPI Urban Europe; EIP Smart Cities
- In relation to impact of transport/traffic on climate change and pollution: MARTEC II; ERA-NET TRANSPORT II; ERA-NET AirTn; (all not in the table)

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61 Source: ERALEARN

D 4.1 ERA.Net RUS Foresight Report Page 65 of 256
### TABLE 6: Current ERA initiatives in the area of environment

<table>
<thead>
<tr>
<th>ERA-NET</th>
<th>ERA-NET +</th>
<th>ART. 185</th>
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62 Source: ERALEARN
7 Recommendations and Measures to be taken

In the previous chapters we have shown the status of RDI cooperation between the EU, the EU MS/AC and Russia. We have outlined the results of a Delphi survey among a solid sample of researchers and policy makers involved in the cooperation concerning structural and thematic cooperation. And we have discussed relevant instruments for supporting the cooperation, as well as framework conditions influencing it. In this chapter, we suggest avenues to enhance the cooperation between the EU and Russia in RTDI. With the suggested measures we aim at advancing the cooperation closer to the positive “R&D paradise” scenario, which was voted overwhelmingly as the ideal scenario, but far less realistic one. The measures can be categorised in two groups:

- Measures at the level of framework conditions for the cooperation
- Measures at the level of support instruments

7.1 Measures at the level of framework conditions

The legal and policy environment for RTI in the EU and Russia and between them determine the possibilities for cooperation. In addition, the culture of doing business and research have also an important influence.

7.1.1 Legal framework

EU-Russia S&T agreement

At the multilateral level the EU-Russia S&T agreement is the main legal document on which the cooperation is based. It was concluded in 2010. In late 2012 and early 2013 the results of the agreement were reviewed by an international panel of four experts (two nominated by the EU and two by Russia), experienced with the cooperation. The review found out that “EU-Russia S&T cooperation is very intensive, mostly well balanced and efficient and – so far - successful. Many of the thematic priorities in S&T policies of the EU and Russia are compatible, and each of the partners have high level and potential of S&T knowledge and expertise.”

The agreement is crucial as a basis for RTI cooperation, for tax free status of research grants provided by the EU, and for its cooperation forum, the EU-Russia S&T committee and working groups under it. It provides a basis for and underpins the EU-Russia strategic partnership in research.

Measure: A prolongation of the agreement was recommended by the review panel. This prolongation should be concluded as soon as possible and still in 2013.

EU-Russia cooperation agreement

The EU concluded a Partnership and Cooperation Agreement with Russia in 1997. This agreement was concluded for an initial duration of 10 years and has been automatically extended beyond 2007 on an annual basis. Negotiations on a comprehensive follow-up agreement started in July 2008, but have not much advanced yet. A new agreement would be a key instrument to deeper cooperation and economic integration between the EU and Russia in the near future.

Measure: Negotiations on a new comprehensive EU-Russia cooperation agreement should be speeded up and lead to a new agreement to allow for deeper cooperation.

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63 Review of the S&T Cooperation Agreement between the European Union and Russia, 2013.
Regulatory issues: visa, customs and IPR
The EU as well as Russia require visa for citizens of the partner region. This visa issue has been bemoaned on many occasions as a hampering factor to RTI cooperation. It was again confirmed in the ERA.Net RUS Delphi survey 2012, where several experts requested the lifting of visa procedures. The EU and Russia have tried to advance on this issue and concluded a visa facilitation agreement. This has made scientific visas cost free and an invitation letter of the hosting organisation sufficient for visas. Nevertheless it imposes a burden on researchers to fill in the requested administrative information, and more importantly it is a time consuming exercise. Russia has repeatedly suggested lifting visa procedures. Another regulatory issue to be addressed by policy makers concerns customs and the exchange of scientific material and equipment. An efficient research and innovation cooperation needs to purchase and exchange material and equipment quickly. As our survey showed, this is not ensured currently. Finally Intellectual Property Rights (IPR) are indicated as another issue, which hampers cooperation in some fields. Lack of transparency, bureaucracy, complicated legal procedures in Russia, etc. have been mentioned here in the ERA.Net RUS Delphi survey.

Measures:
- Continue efforts for lifting of visa procedures between the EU and Russia. Consider lifting visas for researchers (such as those involved in FP7 or Horizon 2020 projects), e.g. on the example of visa free travel for sportsmen introduced by Russia.
- Make customs regulations research and innovation friendly, and facilitate exchange (import/export) of scientific material and equipment.
- Increase transparency of Russian IPR, align IPR regulations between the EU and Russia, and make IPR procedures less bureaucratic.

7.1.2 Cooperation fora
EU-Russia summits
The main cooperation forum at the highest level between the EU and Russia are the biannual EU-Russia summits. Research and innovation are issues which are also on the agenda of the summits, for example the EU-Russia Year of Science 2014 was announced as one of the results of the EU-Russia summit in December 2012.

EU-Russia S&T Committee and Working Groups
A dedicated forum, the EU-Russia S&T committee, and ten EU-Russia thematic working groups (e.g. aeronautics; energy; environment; etc.) have been established under the S&T Agreement. The working groups have not fully met the expectations, as some have not convened regularly or provided the input expected. Both for the EU and for Russia, new programming periods for their main RTI programmes will start with the end of 2013 and beginning of 2014. At the EU the new Horizon 2020 programme will start and in Russia the new Federal Targeted Programmes for research in priority fields and for R&D personnel.

Measures:
- Conclude the S&T agreement and continue the cooperation forums to ensure a smooth transfer to the new programming periods.

• Continue the working groups into Horizon 2020 and the Russian FTPs, by adapting them to the necessities and structure of the new programmes.

• Ensure commitment of the working groups to their task and regular meetings.

Common Spaces
At the St. Petersburg summit in May 2003, the EU and Russia agreed to reinforce their cooperation by creating four common spaces, which include a space on Research, Education and Culture designed to promote scientific, educational and cultural cooperation. For the implementation of the spaces, roadmaps have been agreed. The current EU-Russia roadmap on scientific and technological cooperation for the years 2011-13 covers thematic fields and sub-programmes of the FP7. Measures comprise among others the identification of thematic priorities for cooperation, facilitating the participation of Russian teams in the FP, and furthering the mobility of researchers.66

Measure: Continue updating and following-up the roadmaps for the common space on research, education and culture.

Modernisation Partnership
The principles and objectives of the Partnership for Modernisation were defined at the EU-Russia Summit in Rostov-on-Don in 2010. The Partnership for Modernisation is a shared agenda to help bring about reform in the area of socio-economic development, with due respect for democracy and the rule of law. Its priority areas include investment and trade, the alignment of technical standards, the promotion of a sustainable low-carbon economy and dialogue with civil society. It is a pragmatic and flexible framework which provides additional momentum to the EU-Russia relations. It is accompanied by 25 bilateral modernisation partnerships between Russia and EU Member States. The Partnership is in full implementation phase.67

Measures:
• Make use of the modernisation partnership for the benefit of research and innovation cooperation among the EU MS/AC and Russia.
• Consider using support instruments such as the modernisation partnership facility for research and innovation facilitation.

An EU-Russia Permanent Partnership Council on Research met once in Ljubljana, in 2008. It convened at minister level to assess the status of research cooperation. It “noted that an eventual association of the Russian Federation to the 7th Framework Programme on Research and Technological Development would take Russia-EU scientific and technological cooperation to a new qualitative level. [It] stated that the European Research Area would be enriched and strengthened by Russia also becoming a full part of it.”68

Measure: Consider re-convening the PPC on research as a high-level forum to support the strategic EU-Russia partnership on research.

SFIC Pilot Initiative on Russia
A Pilot Initiative on RDI cooperation with Russia has been proposed in the frame of the Strategic Forum on International S&T Cooperation (SFIC) in spring 2013. Such Pilot

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66 Progress reports on the Common Spaces are available at: http://eeas.europa.eu/russia/common_spaces/index_en.htm


Initiatives are already underway for countries such as Brazil, China, India, and USA. They focus usually on information exchange and coordination among EU MS/AC towards a certain target country, but include also joint RDI funding activities with the target country.

Measures:
- It is recommended that SFIC proceeds with the Pilot Initiative with Russia in 2013.
- Pilot Initiatives with other Third Countries (e.g. India, USA) should be studied. Good practice from these pilots should be applied in the Russia initiative.
- Comprehensive funding cooperation should be considered, for example initiating an Article 185 TFEU cooperation in the frame of the SFIC initiative (details see below).

7.1.3 Cooperation Environment

Culture of business and research performance

One of the main issues endangering cooperation with Russian RTI actors mentioned by respondents to the ERA.Net RUS Delphi survey was corruption in Russia. For the EU side the main hampering issue was bureaucracy.

Measures:
- Enhance efforts to combat corruption in Russia in the RTI sector.
- Enhance efforts to combat bureaucracy in the EU in the RTI sector (in particular in funding).

International regulatory environment

Russia acceded to the World Trade Organisation (WTO) in 2012. It is also in the accession process for becoming member of the Organisation for Economic Cooperation and Development (OECD). These processes and memberships provide for a more stable and reliable regulatory environment among the EU and Russia for its RTI cooperation.

Measure: Russia and EU MS/AC among OECD members to follow-up on Russian OECD membership.

Issues from the ERA.Net RUS Delphi survey

An important cleavage could be noted for perceptions of support of the EU MS/AC-Russia RTI cooperation among researchers and policy makers. Both the EU and Russian respondents supposed that the idea of RTI cooperation between the EU and Russia would be very or rather strongly supported by the scientific community in their countries (68% and 81% respectively). The opinion of the respondents about the policy makers’ support of RTI cooperation was different. While about half of EU experts expected that EU-Russia RDI cooperation would be weakly or very weakly supported (53%) by policy makers, 80% of Russian respondents voted for weakly or very weakly supported.

The following framework conditions were ranked as very important for the cooperation: Increasing R&D investment was the key issue for EU-Russia RTI cooperation (684 respondents). Many experts also underlined the importance of availability of financial instruments to support S&T cooperation (499 respondents), as well as training and education of highly qualified RTI personnel (478 respondents). Quite relevant were still investment in research infrastructure and equipment, and S&T policy dialogue.
Among the open questions to the survey the following responses were relevant:

- In general, the majority of respondents welcomed any increase/improvement in the EU/Russia cooperation.
- The need for financial support of research cooperation and appropriate instruments (e.g. joint fund, INTAS like instrument) were mentioned frequently.
- More support for exchanges and mobility of researchers was highlighted by respondents.
- Political will was stressed by many as a determinant factor for the success of any cooperation scheme.
- Basic research was highlighted as important to be supported.

**Measures:**

- Address the perception that RTI cooperation is weakly supported by policy makers.
- Continue and make the S&T dialogue more effective for underpinning the RTI cooperation.
- Show commitment at the policy level by focusing on generating results, such as improving framework conditions for the cooperation, implementing a SFIC Pilot

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69 Source: ERA.Net RUS Foresight Report, 2013
Initiative on Russia, increasing the investment in the RTI cooperation EU MS/AC-Russia, developing new support tools and scaling-up of already existing instruments.

- Consider measures for addressing the need for training and education of qualified R&D personnel.
7.2 **Instruments supporting cooperation**

Support instruments are crucial for facilitating cooperation among RTI actors.

### 7.2.1 Projects in support of EU-RU RTDI cooperation

Coordination and support actions funded under the FP6 and FP7, such as the BILAT-RUS, the ACCESSRU, the INCO-Net EECA projects have facilitated EU-Russia RTI cooperation. They allowed establishing a solid analytical base on the cooperation, supported networking among research and innovation actors, provided new impetus by suggesting cooperation instruments, and provided for S&T and related political dialogue. They highlight priority areas of cooperation (e.g. thematic fields), include foresight exercises, monitor and assess the cooperation, and allow EU MS/AC to cooperate in a variable geometry approach with target countries. These coordination and support projects accompany the cooperation in a complementary way.

The ongoing BILAT-RUS Advanced project has started in autumn 2012 and will continue through to autumn 2015. It will be an important tool in support of the EU-Russia Year of Science 2014.

Such supporting projects were also funded within the Russian FTP R&D in priority fields.

**Measure:** Continue to fund coordination and support actions in Horizon 2020 and in Russian FTPs to analyse, facilitate and accompany the RTI cooperation.

### 7.2.2 FP7 and Horizon 2020

The framework programmes provide for the most significant funding tool for the EU-Russia RTI cooperation at the multilateral level. Russia is traditionally the most important third country cooperation partner in the FPs (e.g. in FP6 and FP7), which is not an EU Member State or a country associated to the FP.

Russia had declared in 2008 its interest in upgrading cooperation through an association to FP7. However this did not realise and for Horizon 2020 the perspectives for association are for the moment dim. The new international cooperation strategy of the EU does not foresee for Russia an associated status and moreover, Russia will have to cover the costs of participating Russian teams from own resources as will do other important emerging economies, such as China, India or Brasil. To keep the Horizon 2020 as a major cooperation tool, measures will have to be taken to ensure maximum Russian participation in it.

**Measures:**

- Russian policy makers should consider introducing a support tool for Russian participants in Horizon 2020 projects.
- Appropriate funding mechanisms (grant funding, etc.) will have to be developed in this case by Russia.
7.2.3 ERA.Net RUS and ERA.Net RUS Plus

European Research Area Networks (ERA-NETs) aim at coordinating national research and innovation funding programmes and at pooling of resources for joint calls for research and innovation projects. ERA-NETs offer several advantages for EU MS/AC – Russia RTI cooperation: thematic fields of ERA-NET calls are defined jointly with the other funding partners, the management of calls for project proposals is agreed and performed jointly, and national funding sources are mostly flowing back to the research teams of the country where the funds originate from (juste retour principle). Research funding cooperation is organised herewith at an equal footing among interested partners from the EU MS/AC and Russia. The coordinated approach in the ERA-NET enables pooling of financial resources and concentrating administrative efforts on joint funding activities. It opens up the possibility for multinational consortia formation with involvement of players from different environments: companies, public research organisations, and higher education institutions. And it allows countries that do not see the need for an own bilateral funding program to embed their stimulation activities in a broader multi-partner and multinational environment.

The ERA.Net RUS has successfully implemented calls for S&T and innovation projects. Based on the first success, Programme Owners have decided to continue the good cooperation and submit an ERA-NET Plus project proposal to the EU. This ERA.Net RUS Plus project was approved for funding and will start in November 2013. The consortium managed to attract new funding partners to the Group of Funding Parties (e.g. from Germany, Moldova). The further evolution path should lead to an activity according to Article 185 TFEU (in detail described below).

**Measures:**

- Ensure continued dissemination of ERA.Net RUS project results through the project coordinator and consortium members to appropriate target groups.
- In the ERA.Net RUS Plus increase the transparency of project selection procedures through making the evaluation results and comments available to proposers to the calls.
- Stimulate additional funding parties to participate in the ERA.Net RUS Plus calls (e.g. from Austria, Norway, Russian Ministries, etc).
- Ensure proper dissemination and implementation of the ERA.Net RUS Plus calls for S&T and innovation projects.

7.2.4 Article 185 cooperation

Article 185 of the Treaty of Lisbon on the Functioning of the EU (TFEU) provides a legal basis for the Union to participate in the joint implementation of national research programmes undertaken by several Member States. It offers the possibility to combine EU, national and regional efforts into single European programmes. The Union provides support beyond a simple coordination of research programmes in that it requires a scientific, management and financial integration process. So far, five Article 185 Initiatives have been set up.

The most relevant in our context is the Joint Baltic Sea Research and Development Programme (Bonus, Decision 22/09/2010), as it involves with the Russian Foundation for Basic Research (RFBR) a Russian funding partner. RFBR is not member of BONUS, but finances the participation of Russian researchers in projects supported under BONUS on the basis of an agreement RFBR-BONUS. BONUS has a budget of € 100 million, whereby up to 50% are coming from the European Union.

The five Art. 185 initiatives are not subject to the Rules for Participation of FP7 and are based on the Rules for Participation of national programmes concerned – provided that they are compatible with EU legislation plus any additional requirement which may be imposed by the
Delegation Agreement. De-facto this means that FP7 rules have to be observed mostly. The initiatives are implemented by indirect centralised management through a Dedicated Implementation Structure (DIS) which is responsible for the administrative, financial and contractual management of a joint research programme.

All running initiatives are opting for a successor programme based on Art. 185 in Horizon 2020.\textsuperscript{70} They will have to apply the Horizon 2020 Rules. Additional Art. 185 cooperation initiatives are under preparation for Horizon 2020. This concerns for example an Art. 185 cooperation for the Mediterranean region, named PRIMA, or another Art. 185 funding initiative considered for the Danube region in the framework of an upcoming Danube INCO-NET.

Given the strategic partnership in research between the EU and Russia, the strong performance of Russia in the FPs, that an ERA.Net RUS Plus has already been approved and will start implementation in November 2013, and that other regional Art. 185 cooperations are in preparation, a logical follow-up to the ERA.Net RUS Plus would be an Art. 185 cooperation for the EU-Russia RTI cooperation.

**Measures:**

- Analyse the potential and interest of Russian funding organisations for participating in other Art. 185 cooperations than BONUS. Facilitate the participation of Russian funding organisations in case of interest.
- Explore with the ERA.Net RUS and ERA.Net RUS Plus Groups of Funding Parties options for an Art. 185 cooperation.
- Explore with the European Commission the perspectives and concrete steps to be taken for preparing an Art. 185 cooperation.
- Establish a task force to advance the work on this cooperation.
- Collect opinions from additional funding parties, which may be potentially interested in such a cooperation.
- Prepare a strategic research agenda on the basis of the thematic foresight, in particular the thematic roadmapping workshops.
- Scale-up resources for an Art. 185 and envisage a long term cooperation programme (e.g. 5–7 years).

### 7.2.5 Thematic ERA-NETs

Russian R&D and innovation funding organisations become more and more involved in thematic ERA-NETs. ERA-NET participations under the FP6 have generated only limited results. However, under the FP7 these have become more substantial and successful. Russian funding organisations have participated or are still participating in a number of thematic ERA-NETs such as ERA-IB 2 - the ERA-NET "Towards an ERA in Industrial Biotechnology" 2, ASPERA 2, etc and have successfully co-funded calls for projects in these ERA-Nets.\textsuperscript{71}

**Measures:**

- Continue supporting and stimulating participation of Russian funding parties in thematic ERA-NETs.
- Identify ERA-NETs in promising areas of EU-Russia RTI cooperation and stimulate the ERA-NET as well as Russian funding parties to cooperate.
- Attract new Russian funding parties, such as the Ministries, to ERA-NETs.

\textsuperscript{70} European Commission, Fifth FP7 Monitoring Report, 2012

\textsuperscript{71} For a complete list of Russian participation in ERA-NETs see the ERA.Net RUS Foresight Report.
7.2.6 Coordinated calls EU-Russia within FP7 & Horizon 2020

Since 2007 several coordinated calls for co-funded research projects between the EU and Russia were implemented in the frame of the FP7. Coordinated calls have been completed in such areas as health; food, agriculture and biotechnology; ICT; energy; aeronautics; nanotechnologies; nuclear energy.

**Measure:** in case that coordinated calls with third country partners will be continued in Horizon 2020, a broad variety of scientific fields should be covered with coordinated calls with Russia and the financial commitments be scaled up.

**Other EU funding tools**

Russian scientists and teams participate in projects of the European initiatives COST and EUREKA. Russia has the highest participation in COST actions, of all countries not being a member of COST. What concerns EUREKA, Russia is member since 1993. But participation of Russian organisations is in comparison to the duration of its involvement rather low. This confirms the limited innovative capacities available in the country, a lack of appropriate innovative companies and administrative barriers in the management of EUREKA. Russia is not yet member of EUROSTARS, the EUREKA funding tool co-funded by EUREKA member states and the European Commission.

**Measures:**

- Russia should take full advantage of its EUREKA membership. A clear organisational structure and funding mechanism for EUREKA projects in Russia is recommended.
- Russia should consider participation in EUROSTARS.

7.2.7 Russian R&D funding tools

Attracting leading scientists to Russian universities has proven to be useful tool to stimulate inward researcher mobility to Russia. It has focused on a narrow group of leading scientists until now. However, the initiative is considered to have been very successful. In currently three application rounds (2010, 2011 and 2012) more than 1,500 scientists from all over the world participated and 121 scientists were selected. The amount of funding per project is with around EURO 3 million considerable. Due to the great success and response, the initiative will be continued. Also, the Russian Federal Targeted Programmes show more and more participation of EU Researchers, e.g. in the FTP R&D in Priority Fields.

**Measures:**

- A broader outreach to stimulate wider groups of EU researchers to work temporarily in Russia could prove very useful and should be considered by policy makers.
- Participation of EU researchers in Russian funding programmes, such as the Federal Targeted Programme for Research in R&D priorities should be stimulated and facilitated.

7.2.8 Russian Innovation Support Tools

In recent years Russia has introduced a broad range of new innovation support tools. These include the Skolkovo Innovation Centre, the State Corporation for Nanotechnologies - Rusnano, the Russian Venture Company, the Russian Foundation for Technological Development (RFTR), Special Economic Zones for Technology Development, Innovative Territorial Clusters, and Technology Platforms. Actors from EU countries have become involved with some of these tools, but there seem to be many more opportunities for cooperation.
Measures:
- Information on these tools and in particular on cooperation opportunities with EU counterparts and actors should be made available. Opportunities for cooperation should be explored and stimulated.
- Stimulate cooperation among EU and Russian Technology Platforms, and explore opportunities for Russian participation in EU Joint Technology Initiatives.

7.2.9 Joint Funding Initiative
A Joint Funding Initiative (or Joint Foundation) for research and innovation support between interested EU MS/AC and Russia could be a fall-back option in case an Article 185 cooperation cannot be realised. As other ERA-NETs have shown (e.g. EraSME), interested funding parties can continue pooling resources and organise calls beyond an EU funded phase. This can be an option for the ERA.Net RUS Plus, after EU funding has expired. The advantage of such an initiative would be more flexibility in the administrative procedures as Horizon 2020 rules would not have to be applied; the disadvantage would be that significantly more financial commitment from EU MS/AC would be required.

Measures:
- Explore the interest in a Joint Funding Initiative among EU MS/AC and Russia, with or without EU funding.
- Consider such an initiative as a fall-back option in case an Article 185 initiative with substantial co-funding from the EU cannot be realised.

7.2.10 Cooperation on research infrastructure
Investment in research infrastructure and equipment was ranked as an important condition for stimulating RTI cooperation in the ERA.Net RUS Delphi survey (see above). EU Member States and Russia are partners in a growing number of international research infrastructures. Russia has committed significant resources in order to participate in the international XFEL (Russian contribution € 250 million) and FAIR (Russian contribution € 178 million) projects under construction in Germany. It is a partner in the International Thermonuclear Experimental Reactor – ITER. Moreover, Russia has recently signed a Memorandum of Understanding with the European Synchrotron Radiation Facility (ESRF) that paves the way to full membership in the next few years, and in December 2012 it announced an expression of interest to join CERN as an associate partner. For many decades already, European organisations have been involved in the Joint Institute for Nuclear Research (JINR) institute in Dubna, Russia. In Russia several infrastructure projects are under consideration and/or construction in the frame of the so-called Mega-Science projects.

Measures:
- Continue the cooperation efforts on research infrastructures and explore cooperation opportunities in the frame of the Russian Mega-Science projects.
- As recommended by the recent review of the EU-Russia S&T agreement, the incorporation of Russia into the European Strategy Forum on large Research Infrastructures (ESFRI) and on its related Roadmap should be considered.
7.2.11 Thematic fields of cooperation

RTI cooperation among EU MS/AC and Russia covers a wide range of thematic fields. This was proven in several contexts, e.g. in the FPs, in bilateral cooperation programmes, in the ERA.Net RUS calls, in the bottom-up funding programme INTAS, etc. Specific topics for research calls have been elaborated in the ERA.Net RUS foresight, in so called thematic roadmapping workshops. In these workshops societal challenges of the Horizon 2020 were combined with Russian research priorities. They were assessed by researchers from EU MS/AC and Russia, who were nominated by ERA.Net RUS Plus Funding Parties. As a result the most promising topics in the four pre-defined research areas nanotechnologies, health, social sciences and humanities, and environment and climate change were specified. One way to increase cooperation on the promising topics is to build on existing EU initiatives related to those topics (see table 7 below).

**TABLE 7: Existing initiatives in the EU related to the thematic topics for EU–Russia S&T Cooperation**

<table>
<thead>
<tr>
<th>Health</th>
<th>Nano</th>
<th>SSH</th>
<th>Environment and climate change</th>
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</thead>
<tbody>
<tr>
<td>AAL Art. 185</td>
<td>EMRP Art. 185</td>
<td>JPI Urban Europe</td>
<td>BONUS Art. 185</td>
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<td>EDCTP Art. 185</td>
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<td>EIP Smart Cities</td>
<td>EMRP Art. 185</td>
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<tr>
<td>EMRP Art. 185</td>
<td></td>
<td>Cultural Heritage</td>
<td>BIODIVERSA2</td>
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<td>NEURON II</td>
<td></td>
<td>ERANET+</td>
<td>CIRCLE-2</td>
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<td>ERA-Net</td>
<td></td>
<td>JPI Cultural Heritage</td>
<td>ERA-ARD-II</td>
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<tr>
<td>JPI Neurodegenerative diseases</td>
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<td>CRUE ERA-NET</td>
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<tr>
<td>EUROCURSE</td>
<td></td>
<td></td>
<td>JPI Climate Clik´eu</td>
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<td>INFECT-ERA</td>
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<td>CRIE ERA-NET</td>
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<tr>
<td>TRANSCAN</td>
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<td></td>
<td>JPI Cultural Heritage</td>
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<td>EURANID</td>
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<td>JPI healthy and productive seas and oceans</td>
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<td>JPI Water challenges</td>
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<td>Seas-ERA</td>
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<td></td>
<td></td>
<td></td>
<td>EIP Water Efficient Europe</td>
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<td>ERA-MIN</td>
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<td></td>
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<td>JPI Urban Europe</td>
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<td>MARTEC II</td>
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<td>ERA-NET TRANSPORT II</td>
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<td>ERA-NET AirTn</td>
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</tbody>
</table>
Measures:

- Try to support a broad range of thematic fields in the EU MS/AC – Russia RTI cooperation, from basic research to innovation. This can be done in a complementary way over various funding instruments at multilateral and bilateral levels.
- Take up and use topics selected in ERA.Net RUS thematic roadmapping workshops for calls.
- Consider Russian participation in currently ongoing initiatives in the EU that are related to the topics identified.
- Combine bottom-up and top-down approaches for supporting thematic areas in the cooperation. In top-down support, use solid methodologies to select the most appropriate thematic fields and call topics for the EU MS/AC and Russia RTI cooperation (e.g. input from ongoing cooperation, expert workshops, foresight methodologies, etc.)
### TABLE 8: Overview of measures

<table>
<thead>
<tr>
<th>Measures</th>
<th>Sustainability</th>
<th>Competence</th>
<th>Cooperation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy level</strong></td>
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<tr>
<td>Prolongation of the EU-Russia S&amp;T agreement</td>
<td>X</td>
<td>X</td>
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<tr>
<td>EU-Russia cooperation agreement</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Regulatory issues: visa, customs and IPR</td>
<td>X</td>
<td></td>
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<tr>
<td>EU-Russia S&amp;T committee and working groups</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Common spaces</td>
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<td>X</td>
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<tr>
<td>Modernisation partnerships</td>
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<td>X</td>
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<tr>
<td>EU-Russia Permanent Partnership Council on Research</td>
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<tr>
<td>SFIC Pilot Initiative on Russia</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Culture of business and research performance</td>
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<td>X</td>
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<tr>
<td>International regulatory environment</td>
<td>X</td>
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<tr>
<td>Address the perception that RTI cooperation is weakly supported by policy-makers</td>
<td>X</td>
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<tr>
<td>Show commitment at policy level by focusing on generating results</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Art. 185 cooperation or Joint Funding Initiative</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td><strong>Institutional level</strong></td>
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<tr>
<td>Culture of business and research performance</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Make S&amp;T dialogue more effective for underpinning the RTI cooperation</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Measures for training and education of qualified R&amp;D personnel</td>
<td></td>
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<td>X</td>
</tr>
<tr>
<td>Continue coordination &amp; support actions in Horizon2020; consider support tools for Russian participants</td>
<td>X</td>
<td>X</td>
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8 Conclusions

The comprehensive ERA.Net RUS foresight study confirmed the high interest among researchers and policy makers to further develop and enhance the RTI cooperation between the EU, the EU MS/AC and Russia. While a very optimistic scenario for cooperation was assessed overwhelmingly (by 95% of survey respondents) as rather or very desirable, it seemed to a majority of respondents as rather or very unlikely to realise. It can therefore be considered as a “goal scenario” to be targeted by the EU and Russia.

The study has led us to concrete recommendations and measures for enhancing the framework conditions, as well as the support instruments for the RTI cooperation. Furthermore, in the thematic branch of the study, specific promising topics for cooperation, and in particular for calls for research and innovation projects (e.g. ERA.Net RUS Plus call for S&T projects 2014) have been singled out. These measures and recommendations will help to move the cooperation closer towards the goal scenario over the coming years.

The results of this foresight exercise were used a basis for a Vision Paper on development perspectives of RTI cooperation. The paper proposes a vision on enhancing the cooperation between EU MS/AC and Russia overall, as well as a specific follow-up vision for the ERA.Net RUS and ERA.Net RUS Plus projects in the form of a cooperation according to Article 185 Treaty on the Functioning of the EU (TFEU). At this point, when an association of Russia to the EU’s Horizon 2020 programme seems out of sight for a near future, an Art. 185 cooperation appears to be the most promising avenue for a follow-up cooperation to the ERA.Net RUS Plus and for enhancing the cooperation in general. A fall-back option in case an Art. 185 cooperation cannot be realised, could be a joint funding cooperation among interested EU MS/AC and Russia with or without EU funding, such as a Joint RTI Foundation.

The recommendations and measures have been operationalised in a concrete action plan, which suggests how to proceed in a short and longer term future for reaching the goal of enhanced cooperation.

The foresight reached out to broad target groups involved in the EU, EU MS/AC and Russia RTI cooperation. The foresight succeeded to disseminate, involve and communicate the foresight process, intermediary and final results to the suitable target groups and at suitable events.

- Researchers from EU MS/AC and Russia cooperating on joint research were broadly involved in the foresight process through a Delphi survey.
- Policy makers from the EC, the EU MS/AC and from Russia were involved in various expert workshops.
- Thematic foresight results were communicated directly to the ERA.Net RUS and ERA.Net RUS Plus consortiums and Groups of Funding Parties, to the thematic directorates concerned within the European Commission Directorate General for Research and Innovation, and to the EU-Russia S&T committee (meeting of June 2013).
Annex

ERA.Net RUS Foresight Report

Linking Russia to the ERA: Coordination of MS’/AC’ S&T programmes towards and with Russia

**ANNEX**

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8 Annexes

8.1 Annex 1: Background on Art. 185 cooperations

Article 185 of the Treaty of Lisbon provides a legal basis for the Union to participate in the joint implementation of national research programmes undertaken by several Member States, and thus provides a key building block of ERA because of the possibility it offers to combine EU, national and regional efforts into single European programmes. Article 185 Initiatives are set up at European level to address strategic areas where research and innovation are essential to European competitiveness. They have been introduced as another means of implementing the Seventh Framework Programme in areas selected in the Specific Programmes. The Union provides support beyond a simple coordination of research programmes in that it requires a scientific, management and financial integration process. So far, five Article 185 Initiatives have been set up.

The pilot Art. 185 initiative under FP 6 is the European and Developing countries Clinical Trials Partnership (EDCTP, Decision 16/06/2003) which is the only one implemented via a grant agreement with an EU contribution of € 200 million. The four initiatives launched in FP7 are implemented by a general agreement between the Commission and the Dedicated Implementation Structure (DIS) and have entered the same pipeline at different times and therefore find themselves today at various developmental stages:

- Ambient Assistant Living (AAL, Decision 09/07/2008)
- EUROSTARS (Decision 09/07/2008)
- European Metrology Research Programme (EMRP, Decision 16/09/2009)
- Joint Baltic Sea Research and Development Programme (Bonus, Decision 22/09/2010)

The EU contribution for these 4 initiatives under FP7 is about €500 million.

The five Art. 185 initiatives are not subject to the Rules for Participation of FP7 and are based on the Rules for Participation of national programmes concerned – provided that they are compatible with EU legislation plus any additional requirement which may be imposed by the Delegation Agreement. The initiatives are implemented by indirect centralised management through a DIS which is responsible for the administrative, financial and contractual management of a joint research programme.

The Ambient Assisted Living (AAL) Joint Programme aims to use intelligent products and provide remote services, to extend the time elderly people can live independently in their home environment. AAL is implemented by 20 EU Member States and 3 Associated States. The programme's planned total budget is € 700 million, with € 150 million funded by FP7.

EUROSTARS addresses research and development performing SMEs and is undertaken by 32 countries, in the context of EUREKA, with a planned overall public contribution of € 400 million, € 100 million coming from FP7.

The European Metrology Joint Research Programme (EMRP) is an initiative undertaken by 22 countries raising € 400 million of public funding with € 200 million coming from FP7. It responds to growing demands for cutting-edge metrology, particularly addressing grand challenges like metrology for environment, energy or health or emerging technological areas, targeting innovation and scientific research and support for policy. EMRP is the first Article 185 Initiative to be developed using ERA-NET Plus as a bridging measure.

The BONUS Joint Research Programme evolved from an ERA-NET plus action and involves all eight EU countries surrounding the Baltic Sea with the aim of creating a cooperative, interdisciplinary, well-integrated trans-national strategic research programme for the Baltic
Sea region. The total FP7 contribution amounts to € 50 million and is matched equally by contributions from the participating states. In this case also, and ERA-NET Plus action has been used for the first joint call. The implementation of the programme is divided into a strategic phase where the operational modalities are established and an implementation phase (which will last for a minimum of 5 years). Operational modalities, common funding rules and rates are now agreed by all participating states and steps towards signing of an implementation agreement between the Commission and the DIS is underway.

With regard to EDCTP (European and Developing Countries Clinical Trials Partnership), launched in 2003 under FP6 (providing a total of € 200 million for this initiative) and aimed at accelerating the development of medical products and interventions against HIV/AIDS, malaria and tuberculosis in developing countries, in particular in sub-Saharan Africa, the Commission adopted a Progress Report in October 2008 following a first Independent Expert Review in 2007. A no-cost extension for the implementation of the FP6 grant until May 2015 was granted based on the recommendations of the second independent expert evaluation conducted in 2009/2010. In the Communication from the Belgium Presidency of the Council of the European Union to the Competitiveness Council in November 2010, the second phase of the EDCTP with an enlarged scale and scope was called for. To that end, the FP7 work programme 2012 included a Support Action with the EDCTP as named beneficiary for a grant of up to € 10 million for activities in support to the preparation of the second phase of the European and Developing Countries Clinical Trials Partnership (EDCTP2) starting in 2014. The interim evaluations of both Eurostars and AAL have been completed during 2010 and the interim evaluation for EMRP was undertaken in 2011. These evaluations have shown that the use of Article 185 of the TFEU has created substantial leverage effects and real European added value by integrating national programmes and pooling resources.

The annual Joint Programming Event on 9-10 November 2011 organised by DG Research and Innovation included a parallel session on the Art. 185 instrument ('Article 185 initiatives for joint research programmes: A model for programme integration of public-public partnerships (P2Ps)?)' and attracted ERA-NET and Joint Programming Initiative (JPI) coordinators. For the first time also, a dedicated meeting between EC officials and Art. 185 initiatives' coordinators took place. This meeting was very well received by both the coordinators and EC officials. In view of the fact that all running initiatives are opting for a successor programme based on Art. 185 in Horizon 2020, other such dedicated meetings will be organised.1

**BONUS**

The joint Baltic Sea research and development programme BONUS began in June 2010 with both the European Parliament and the European Council supporting it. Since its inception, it has secured funding of up to EUR 100 million to fund research and innovation projects from 2013 to 2018. Half of the BONUS funding originates from the national funding institutions in the eight EU Member States around the Baltic Sea and half from the EU's Research Framework Programme. Its predecessors were an ERA-NET and an ERA-NET Plus project. A competitive call for proposals was launched in the frame of BONUS on 12 November 2012. It will be providing EUR 38 million to support top research projects targeting the protection of the Baltic Sea. Two main areas are covered: EUR 31 million is being provided to research supporting the management of a viable Baltic Sea ecosystem, while EUR 7 million will target innovative technological solutions. BONUS is funded by the EU Commission's Research Framework Programme (FP7) and the national funding institutions in the Baltic Sea countries.

1 European Commission, Fifth FP7 Monitoring Report, 2012
BONUS has jointly with policymakers and other end-users developed a strategic research agenda, which is serving as the basis for the projects to be funded. By engaging policymakers and other end users from the very beginning of the programme, it was ensured that the knowledge produced is fit for purpose and well communicated to those who really need it.

The deadline for submitting 'Viable ecosystem' proposals is 14 February 2013 and projects can apply for up to EUR 4 million for 4 years per project. To be eligible, projects must be interdisciplinary (for example, they must include natural sciences and socioeconomics) and transnational, and involve at least three eligible legal entities independent of each other, from EU Member States or Associated Countries. At least two project partners should originate from the BONUS Member States of Denmark, Germany, Estonia, Latvia, Lithuania, Poland, Finland or Sweden. Russian scientists can participate in the projects through funding made available by the Russian Foundation for Basic Research or other special agreements.

The innovation part of the call will be implemented in collaboration with BSR Stars, a flagship project of the EU strategy for the Baltic Sea Region. Individual innovation proposals can apply for a maximum EUR 0.5 million for three years. Innovation proposals are accepted until 12 March 2013.
8.2  **Annex 2: Initial Scenarios**

8.2.1  **ERA.Net RUS Foresight Exercise: Scenario 1: R&D Policy Paradise**

**STORY**

Russian Innovation News, Moscow
20 December 2020

**EU Russia RDI cooperation rolling smoothly ahead**

The year 2020 is coming to an end in a few days, and we look back at a decade of prosperous cooperation in Research, Development and Innovation (RDI) between the EU and Russia. Russia’s participation as an associated country in the EU’s Horizon 2020 programme has proven an unexpected huge success. The presidents, both of the EU and Russia have gathered in Moscow to celebrate the achievements and sign the association agreements for the next programming period, to the EU’s new funding tool, Innovation for the Future 2030.

A major conference was organised as a side event to the signature procedure, where the achievements of the last ten years of cooperation were discussed. Our correspondent took the opportunity to interview the Russian Minister of Research and Innovation.

**Correspondent:** Minister, ten years ago, one would not have thought of such a tremendous increase in scientific cooperation between the EU and Russia. How could that happen?

**Minister:** The basis for this positive development was laid around the year 2010, when Minister Fursenko and his team took important measures for internationalising the Russian R&D and innovation system. In addition, the Ministries of Economic Development and Finance stimulated opening up of the economy through deregulation and privatisation, accompanied by a formation of a comprehensive system of innovation, which became responsive to economic requirements.

**Stimulating cooperation at researcher level**

**C:** Which concrete measures were taken?

**M:** Triggered by the constantly strong participation rates of Russian researchers in the EU’s RDI funding programmes (named Framework Programmes – FP at the time), Russia had expressed in 2008 its interest to become associated to the FP7. Although negotiations could not be finalised for the FP7, we agreed with the EU on our full participation in the follow-up programme Horizon 2020. I must thank here the EU that was flexible enough, to open all programme components to participation of Russian organisations. And we have indeed been participating in all programme components, be it the European Research Council for basic research, in societal challenges and most surprisingly in the innovation funding line we became also a competitive partner.

After a short integration phase in the programme, Russia had quickly caught up with Switzerland in participation rates, which always was top in participation among countries associated to the EU’s FPs. Competitors among the BRICS such as China have fallen far behind us in project involvement with EU member states in Horizon 2020. We are still a net payer to the programme, but we are receiving already very significant funding from Horizon 2020 and are moving towards becoming a net receiver of funds in the future.
Not all of our partners in the EU were enthusiastic about our association and full participation in Horizon 2020. But I would like to tell these critics that we bring in significant know-how in fields such as nanotechnologies, space research and ICT. Our national investments in nanotechnologies (e.g. through Rusnano) are now paying off and the results are to a good deal shared with our EU partners. Moreover, the research fields of health, biotechnology, food and agriculture, which have become ever more relevant globally over the last years, have experienced an important increase in our cooperation with the EU.

C: Which other instruments and measures have contributed to this success in cooperation?
M: Another building block of this success story is the Joint EU-Russian RDI Fund (JERD Fund), which was established in 2015 and is celebrating now its fifth anniversary. We are here at the Moscow headquarters of the Fund. It had evolved from coordination efforts among national funding organisations, which were known at the time as ERA-Net projects. Today it is an international organisation with 30+ staff and an annual budget of more than €200 million, which are invested through various funding tools in R&D and innovation projects.

Bilateral RDI programmes between Russia and a broad range of EU member states have been underpinning the cooperation in Horizon 2020. These bilateral programmes have been constantly evolving in number and in funds invested. They stimulate researcher exchange and preparation of projects in Horizon 2020 and for calls in the JERD Fund.

We should also not forget our strong interlinkages with the EU in research infrastructures. We have now more than 5000 Russian permanent research staff at international infrastructures such as at ITER in France, at XFEL and FAIR facilities in Germany. Our external mobility grant scheme, which the Russian Agency for Researcher Mobility manages, has proved a valuable tool. On the other hand we are also very happy that our significant investments in infrastructure, equipment and housing of researchers within Russia were fruitful: we see that our German and French friends regularly send staff to our main research infrastructures for periods of more than one year, especially to our nanotechnology infrastructures at the Kurchatov institute. And we should think especially of our strong university research centres: here we have succeeded with our funding instruments to attract leading foreign scientists. Since 2009, so more than ten years, we are already launching each year this call to attract leading scientists. We have now international research groups working all over Russia, in research organisations and universities. The most successful groups have emerged into research institutes of their own right.

All these programmes have supported and stimulated interaction and cooperation among the researchers, which is a very important individual component for building trust and achieving major research results.

Russia’s steps in the right direction
C: Money alone cannot explain the success of your policy. Remember, one of our emigrated scientists and Nobel laureate mentioned once that he would not move back to Russia for a sack of gold.
M: Today this scientist even has his own research lab at one of our top universities! Of course in the last five years the soaring prices for primary goods – our main exports - have helped to increase importantly Russia’s investment in R&D and innovation. But it is true that money as such is not sufficient. I am grateful to my colleagues in the Ministry of Economic Development and the Ministry of Finance for their straightforward policy. They took many steps in the right direction, which have facilitated this success. Russia had tackled finally the long overdue simplification of its rules: already in 2013 we switched to RDI funding through grants and abolished allocation according to our complicated public
procurement rules. Our strong integration with the EU through the free trade zone, and the accession to the WTO in 2011 and to the OECD in 2013 have all led to an impressive simplification of regulations in Russia and harmonisation with the rest of the world. Visa free travel we agreed with our European partners in 2013, which was important for our participation in Horizon 2020. We have now all already forgotten the stories of European scientists, which saw their projects delayed or stopped due to bureaucratic procedures or interventions of the security services. But let us remember that these troubles happened only ten years ago.

**Companies as cooperation drivers**

**C:** German E.On last week purchased Russian Biofuels. Does the sell out of innovative Russian companies continue?

**M:** We are aware that there were critical voices on this deal. But this is not a one way deal. Russian United Aircraft Corporation just bought a stake of 25% in EADS. These are effects of our close cooperation with EU partners in various frameworks. The government is committed to privatisation; we have helped developing Russian Biofuels with public funds, but now is the time to attract know-how and additional financial resources to guarantee a prosperous development of the company as a subsidiary of E.On.

We see from our statistics that research and innovation cooperation with the EU includes a significant range of private players. Our businesses and even the sector of Small and Medium Sized Enterprises (SMEs), which has seen a strong upswing in the last years, have internationalised and developed strong ties with partners in the EU. The government’s privatisation policy has stimulated national and foreign investment into takeovers of companies and has in general attracted foreign capital flows to Russia. The simplifications of import and export of goods, scientific equipment and material, as well as a simple taxation system have further contributed to strengthen the private initiative. Thanks to the positive business climate many companies are now investing in research and innovation activities. In addition, deregulation has played its part.

And cooperation among businesses is stimulated through specific innovation support tools. Russian organisations are participating on a routine basis in the EU’s Joint Technology Initiatives and Platforms. Russian Technology Platforms have integrated their activities with EU level platforms. Participation of Russian SMEs in the Eurostars programme is increasing impressively and we are committing substantial financial resources to this programme. Joint Funding instruments were developed in the frame of our modernisation partnership with the EU.

Business R&D investment has importantly helped to achieve this year our long term goal of investing 2% of GDP in R&D.

**C:** Admittedly, research is a success story of our cooperation with the EU. What can you recommend your colleagues in the government, who are responsible for other portfolios?

**M:** We have seen many positive repercussions and spill-over effects from research cooperation and the modernisation partnership to other fields of cooperation. Stronger international integration has increased transparency and stimulated simplification of regulation. Russia has fully implemented the Bologna process and aligned its higher education system with EU partners. Our universities are now important hosts for EU researchers and vice versa. Most importantly, Russia’s business climate was never as good as today. We cooperate closely on some matters of security policy, e.g. on organised crime.

To summarise, we look forward to further strengthen our cooperation with our European friends in an innovation partnership and in other frameworks.

**C:** Thank you for the interview!
MAIN ARGUMENTS

Framework conditions for scenario
- Political will on both sides to strengthen cooperation has been translated into enhanced framework conditions for RDI cooperation and joint stimulation instruments
- Russia is member of the WTO & OECD

Economy, markets, competitiveness, economic development:
- Free market, regulated competition
- SME boom in Russia
- Soaring commodity prices generate surplus, which is used partly to fund RDI

Public versus private actors and sectors, private involvement in S&T;
- Focus on areas, where companies expect to take advantage of cooperation/expect most benefits
- Public-Private Partnerships in selected areas (Airbus, gas transportation, etc.)
- A reasonable number of R&D intensive companies in Russia are performing R&D and compete with EU
- Russian system in a transformation phase from publicly dominated to a more significant role of the private sector
- Public research institutions are more open to cooperation with the private sector – companies from the EU cooperate with PROs in RU and vice versa

Regulation and standards – regulatory framework, IPR rules, visa, etc.
- Deregulation and good regulation trend in EU and Russia
- Alignment of Russian regulations and standards with EU
- Common patent system, innovation support in place;
- Improved IPR protection and higher competition stimulate private R&D investment;
- visa lifted;
- convergence of standards (Bologna process, etc);
- Improved regulation in RU: land ownership regulated as a basis for market economy and flourishing of companies
- Property rights better guaranteed in Russia,
- Enhanced rules for employment, import/export and R&D funding system
- Less regulation to set up company in RU and for investment of RU companies in EU
- Grant system introduced for RDI instead of public procurement

Governance and institutional solutions: agreements, institutions,
- Free-trade Zone with EU agreed and implemented
- Association agreement to Horizon 2020 and to follow-up EU funding tools for RDI
- Modernisation partnership evolves into innovation partnership with related funding instruments and/or cooperation among funding bodies
- Joint management committees in place to provide good regulation for the cooperation and to manage the day to day work;
- Russia participates in EU committees for international S&T cooperation (SFIC) and bilateral cooperation forums are continuing smoothly
- Bilateral agreements between companies & universities
S&T cooperation instruments: funding instruments for R&D and innovation available

- Horizon 2020/FP9 association and participation in other EU funding programmes for R&D and innovation will take place, support network for Horizon 2020 participation in RU established, RU participation in JTI’s and JP
- Russian R&D and innovation funding instruments open to EU participation and funding allocation simplified (e.g. public procurement abolished for R&D and innovation funding);
- Joint EU-Russian RDI Fund established and operational

Resources, financial implications

- Increased RDI funding in Russia; target of 2% GERD as a share of GDP has finally been reached
- R&D and innovation funds (financial resources) are used effectively
- High return on investment & on cooperation – balanced between EU and RU; after a period of accommodation, Russia receives significant funds out of Horizon 2020 and moves towards becoming a net receiver
- EU MS/AC companies invest in RU – FDI in R&D and innovation increases significantly
- Significantly higher investment in R&D and innovation by Russian companies

Thematic and structural orientation of cooperation

- Significant increase in applied research and innovation
- Thematically broad cooperation spectre, covering basic and applied research of common interest: aeronautics, biotech, energy, food, ICT, nanotechnologies, physics, space, etc.
- services and social innovations, and organisational innovations (improvements of production processes) a developing area of cooperation and R&D into it will increase
- Strong cooperation in thematic areas, which are of joint interest for companies. Private sector driven cooperation: space, nuclear energy, energy efficiency, energy (oil & gas – exploration, petrochemical industry, geophysics), aeronautics, etc.

Performance of RDI collaboration

- Strong performance, results of cooperation show increased joint publications, patenting.

Qualified human resources, migration, demography

- enhanced exchanges between EU and Russia
- Russia succeeds in attracting qualified human resources for establishing research groups in Russia and for educating the young generation
- Emigration trend of qualified researchers reversed and turned into brain circulation

R&D and innovation infrastructure

- Continued increase of cooperation on large-scale infrastructures (DE – XFEL, ITER, CERN, etc.)
- Stronger investment in Russia into research infrastructure (Kurchatov institute, etc.)
- Funding infrastructure for bilateral cooperation continues to increase: more bilateral programmes, e.g. on the example of the Russian programme: attracting leading researchers to RU Universities, more resources invested, etc.

Cultural Issues

- convergence of managerial styles
- Increasing trust in the joint RDI cooperation and in relations overall
• mentality towards FDI from EU and RU is changing towards a more positive attitude
• Attitude of researchers towards applied research & innovation, cooperation with companies becomes more positive

External Factors
• rising power of world players (China, other BRICS, South East Asia) in R&D and economically is forcing the EU & RU to cooperate

**IMPACT VARIABLES**

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<td>6. Economic development (+ vs -)</td>
<td>+ -</td>
</tr>
<tr>
<td>7. Cultural proximity (+ vs-)</td>
<td>+</td>
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<tr>
<td>8. Thematic diversity (wide + vs narrow-)</td>
<td>+</td>
</tr>
<tr>
<td>9. S&amp;T cooperation instruments (innovative + vs traditional -)</td>
<td>+</td>
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<tr>
<td>10. Qualified HR</td>
<td>+</td>
</tr>
<tr>
<td>11. Regulatory framework</td>
<td>+</td>
</tr>
<tr>
<td>12. Research infrastructure/equipment</td>
<td>+</td>
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</table>
8.2.2 ERA.Net RUS Foresight Exercise: Scenario 2: Empty Cooperation Programming Shell

**STORY**

**Scenario: Empty cooperation programming shell**

The EU and Russia have come closer culturally, Russian movies and music are increasingly popular in Europe and tourist flows between the regions have increased. Among university students Russia has become a popular destination for exchanges. Although Russia is lagging behind its potentials and has been considered as Third Country towards the EU’s Horizon 2020 programme, there is a strong will for S&T cooperation. A number of policies are put in place, which however are empty boxes as they lack effective instruments: they are declarations of good intentions without adequate budgets or adequate implementation plans. New hope comes from ongoing negotiations on the participation of Russia in the EU’s Horizon 2020 follow-up RDI funding programme.

Key problems to an improvement of cooperation are the decreased R&D investment in the years after 2010 (due to the financial crisis) and the lack of qualified personnel, which resulted from the budgetary cuts in the EU and Russia. Furthermore, a major gap is that there are no real incentives for private companies to participate in RDI cooperation. New support instruments, which were established over the years up to 2020 between the EU and Russia focus on public sector research organisations, and do not contain suitable incentives for the commercial drive of the private sector. Furthermore, the policies designed are not able to create public-private synergies, because they focus on the wrong thematic areas (ecology, humanities…). Just to take the example of EUREKA: Russia is member since 1993 and participates since 2013 also in its EUROSTARS funding programme. But cooperation in this framework has continued on the same low scale as in the period 1993-2011.

Russian private companies have become commercially successful and offer better conditions for qualified staff than public research organisations. This has created a strong brain drain from the public to the private sector in Russia. This further undermines the success of the cooperation policies, as it drains the key human resources, who would be able to benefit from the public sector cooperation programmes.

**Some not-so-careful considerations towards the scenario**

Despite its more or less neutral position in the scenario grid, the Empty Cooperation Shell Scenario should be considered very important due to the following reasons:

1. The scenario is definitely a part of the Baseline Scenario of EU-Russian relations. The Baseline Scenario concept encompasses facts and trends that would most likely happen, if no specific projects and measures are taken to change or avoid them. Basically, this is what would happen if we either do nothing or continue doing the things we do in the same manner (which is, actually, the same).

2. The global economic crisis, the de facto termination of EU enlargement, the slow-down and anticipated reshape of technological development and the de facto collapse of the state-centric system of international relations together with its institutions (and its cooperation programmes) would very soon question basis and contents of EU-Russian cooperation in many areas.
3. Very soon EU-Russian cooperation in science and R&D would require a new shape, new institutions, new actors and new dimensions. But despite this demand existing institutions and programmes – the empty cooperation shell - would remain in place for quite a long time.

4. In case of massive bilateral and multilateral investment in S&T relations, the Empty Shell scenario would reshape towards the Xeroxed Projects scenario. However, in both scenario cases the quality of scientific research would decrease and evolve towards a formal approach and mainstream themes.

5. Despite all initiatives, programmes and projects, overall R&D cooperation between EU and Russia is loosing its scientific efficiency. Cooperation instruments are innovative, governance is constantly updated and improved, but as overall investment in RDI cooperation is low and decreasing, no positive influence on scientific and innovation output is generated. People start to think that research inefficiency is normal and “no result is a good result too”. Imitation of results is even better. How long would it take for regional R&D systems to collapse?

6. In this scenario everything LOOKS GOOD but FEELS BAD until it can’t get any worse. Usual cooperation instruments don’t work, and new ones don’t suit regulation and legislation. Everyone it trying to pretend that everything goes fine. The crisis would peak by 2017-2020. It would result in a clean-up of the mess and it might be resolved by 2025-2030 or later.


The chat takes place at the end at the scenario, when general R&D policy crisis finally becomes visible, but no considerable changes were made yet. This is when scientists started to realize that getting politically and economically correct grants and writing papers is probably not what they should call “research”. Nanotech failed to establish a solid platform for breakthroughs and ecological technologies require a new vision towards terraforming and landscape design. But EU legislation and general strategies give them no space for further development. During 2010-s, China, Russia and countries in Latin America redirected and invested important sums of money into research platforms and infrastructure. Moreover, they host a great number of industrial sites, private laboratories and development projects, but which lack human resources. Researchers from EU start exploring new possibilities.

<ScienceTroll> hi pal, its been days! Aint heard from you for a year. Thought you’re dead or so
<RagingDwarf> hi yourself
<RagingDwarf> was offline for my job. Seems I haven’t seen a phone for ages
<ScienceTroll> Johnny you rich bastard!! I wish I could afford even a month offline
<RagingDwarf> it wasn’t a freaking vacation. I’m back to euro only a day or two. We were done with that new research lab in syberia only a week ago.
<ScienceTroll> ftw you spent a year in syberia?? They took you hostage?
<RagingDwarf> lol no. The guys paid us a hell lot of cash. CASH, man! Totally tax-free. Was a great deal to smuggle it in here, you know. My visa was outdated, got to contact consulate and tell them tales.
<RagingDwarf> They really needed that lab in there. 1000 km to nearby city, nuclear powered, full-autonomous tech heaven lol
<ScienceTroll> SWEET. For what?
<RagingDwarf> hell I know, hell I tell. Btw some of the guys were from the EU – dutch, I guess. They said they needed a safe place for their research. Human mind engineering, language studies, all stuff
<ScienceTroll> gosh, the russians are mad about those language and mind tricks. Looks like they want to make a text-based nuke lol. Wonder where they gonna test it, hope not at poor usa again.
<RagingDwarf> lol no but sounded serious enough. They hired a crowd of AI freaks from US singularity institute, and british too, and japs. They even built them a small city in taiga.
<ScienceTroll>damn it I wanna go there. Y I rejected that invitation from Antarctic university??// was too excite with my science career I guess
<ScienceTroll>Syberia - sure there’s no Europol there. Nobody watches you in the shower lol. No chat monitoring, no copyright, no freaking lawyers. Hell, I definitely wanna go there.
<RagingDwarf>write them a sec maybe one time is nothing, no one gonna imprison you for a single one
<RagingDwarf>btw, how’s your phd? In EU science diggs YOU, lol?
<ScienceTroll>you bet
<ScienceTroll>paperwork – that’s what I’m doing. Writing 3 articles a month just to remain in workgroup. You get a grant, you do some work, after a year you get paid. Or you don’t if the media response wasn’t good enough.
<RagingDwarf>man that’s sick
<ScienceTroll>and nobody wants to hear anything new! I mean they give money only to areas written in 5-year old papers, outdated like hell. Who cares now about ecology, huh? Feminism? Man, they still promote works on human rights!
<ScienceTroll>I tried but they don’t need humanitarians, you know. Damn it, their semi-AI text processors are writing articles better than I do. U load info there – you receive a text. “Feminist terrorist groups and their influence over media-based decision-making in context of EU transformation in 2010-s” and all weird stuff like that. They employ only engineers. That’s what they do.
<RagingDwarf> (facepalm) U kidding
<ScienceTroll>Science is dead in the EU, man, science is dead.
<RagingDwarf>go kill yourself lol. Or try tomsk instead. They have some academic exchange with the eu
<ScienceTroll>where is tomsk? What’s there?
<RagingDwarf>science and education. And cheep beer. And cool girls. All stuff you lack in your UK
<RagingDwarf> And a chance to get to those closed labs in taiga. If you are smart enough lol
<ScienceTroll>gimme the address NOW

MAIN ARGUMENTS

Governance, Regulation, Standards
Many programmes, initiatives etc. including Horizon 2020 and its follow-up programme are discussed and some formally implemented, but the vast majority of them remains on an only formal level, without any substantial result.
No further enlargement of the EU. De facto separation between the core and periphery EU countries. Undercover conflicts within the EU on different economic and political issues slow down external activity. Local nationalism and protectionism are growing and complicate international cooperation.
After years of constant negotiations Russia joins the WTO and OECD. In fact, due to political and economic conflicts among key actors the WTO starts loosing its power.
Open-source, copy-paste and local pursuit of innovation challenge the global intellectual property system. It exists only in certain “well-legislated” areas such as the EU. Due to this fact innovative activity starts moving from such areas to the wild: to Russia, Latin America, Asia. Local “wars of standards” in aviation, space, biotechnology, nanotechnology and in next wave of IT.

2 Secured encrypted email for private communications. In 2020 banned in several countries due to counterterrorism and copyright protection laws.
Visa regime between EU and Russia remains in place, despite long negotiations. Actually it is the EU that adds new barriers to the process.

**R&D**

Applied research area is larger than fundamental, but fundamental projects are better financed. This is an attempt to combine both together under the same policy. R&D financing is not sufficient and a lot of explanation and proof of usefulness and an “innovative approach” is required. Tough control over R&D money slows down the research process.

**Private sector cooperation**

Private companies refuse to work with the public sector due to its anticipated low efficiency and bureaucratic barriers. They launch their own transborder R&D networks. Private R&D moving from products to complex services. Decrease in fundamental research. Private companies prefer applied research with clear commercial applications. High corporate R&D investments in Russia and the EU. However, this research has nothing to do with cooperation programmes.

**Public sector cooperation**

Mostly in humanities, ecology, law and several mainstream research areas. The public sector fails to catch new leaps in technology. Public R&D serves state policy, not corporate and market interests. Public and private sectors rival for influence over education. However, the public sector is the only actor that supports fundamental R&D in times of (a rather constant) economic downturn. Despite all initiatives, programmes and projects, overall public R&D cooperation between EU and Russia is loosing its scientific efficiency. Cooperation instruments are innovative, governance is constantly updated and improved, but still no positive influence. People start to think that research inefficiency is normal and “no result is a good result too”.

**Infrastructure**

Continuous investments in common-used infrastructure as legacy of previous initiatives. Common infrastructural and exchange projects are well financed as they are perceived as panacea for decreasing research efficiency. More and more infrastructure is needed for broadening and fragmenting research areas.

**Cultural Issues:**

Russian and EU are closer culturally (cinema, music, tourist). However strong divergence in managerial styles (both in the public and private sector). Such divergence requires more bureaucracy as it undermines trust. “Publish or perish” concept and PR for research outweighs scientific importance.

**External Factors**

Brazil, China, South Africa, even Russia follow their own R&D strategies that differ a lot from EU. New global and local challenges may demand completely new R&D strategy in the EU, which is at least a time-consuming issue. Overall research efficiency is decreasing due to further fragmentation of research areas. New bubbles in global economy endanger support for R&D.
IMPACT VARIABLES

<table>
<thead>
<tr>
<th>Impact Variables</th>
<th>Empty shell</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. S&amp;T policy integration</td>
<td>+</td>
</tr>
<tr>
<td>2. R&amp;D Policy Investment (high vs low)</td>
<td>-</td>
</tr>
<tr>
<td>3. Performance (high vs low)</td>
<td>-</td>
</tr>
<tr>
<td>4. Private involvement (+ vs -)</td>
<td>-</td>
</tr>
<tr>
<td>5. Transparent governance (advanced + vs old fashioned -)</td>
<td>+</td>
</tr>
<tr>
<td>6. Economic development (+ vs -)</td>
<td>+</td>
</tr>
<tr>
<td>7. Cultural proximity (+ vs -)</td>
<td>+</td>
</tr>
<tr>
<td>8. Thematic diversity (wide + vs narrow -)</td>
<td>+/-</td>
</tr>
<tr>
<td>9. S&amp;T cooperation instruments (innovative + vs traditional -)</td>
<td>+</td>
</tr>
<tr>
<td>10. Qualified Human Resources</td>
<td>-</td>
</tr>
<tr>
<td>11. Regulatory framework</td>
<td>-</td>
</tr>
<tr>
<td>12. Research infrastructure/equipment</td>
<td>+/-</td>
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### Empty Cooperation Programming Shell

<table>
<thead>
<tr>
<th>S&amp;I Cooperation</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased R&amp;D investment, and overall decrease in research efficiency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public investment in research infrastructure coupled with very fragmented R&amp;I</td>
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<tr>
<td>Lack of qualified personnel, brain drain from public to private sector</td>
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<tr>
<td>Widespread and unfulfilled need for new institutions</td>
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<tr>
<td>No signs of change in the R&amp;D system</td>
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<tr>
<td>Mismatch of EU and Russian research priorities</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>EU-EU cooperation initiatives fail, visa regime remains in place, EU adds new barriers to RD cooperation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Sector</td>
<td>2010</td>
<td>2015</td>
<td>2020</td>
</tr>
<tr>
<td>No incentives for private participation in RD cooperation, wrong thematic focus &amp; non-adequate instruments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good-working networks of private investments in R&amp;I</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Private R&amp;D moving from products to complex services</td>
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</tbody>
</table>

### Global Politics

<table>
<thead>
<tr>
<th>2010</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>De facto termination of EU enlargement.</td>
<td>Global economic crisis peaks</td>
<td></td>
</tr>
<tr>
<td>Collapse of the data-centric system of international relationships</td>
<td></td>
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<tr>
<td>Rise of EREIS</td>
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</table>
8.2.3 ERA.Net RUS Foresight Exercise: Scenario 3: Isolated R&D Excellence

INTRODUCTION
In this scenario the world economy is becoming multi-polar, with the Asian economic pole producing ~40% of world output. Economic globalisation is accompanied, perhaps surprisingly, by scientific isolation. Every continent (macro-region) is trying to build up the best Ivory Towers to reach highest S&T performances in their specialities and remain competitive. EU-Russia S&T cooperation is therefore fairly limited to specific areas.

In what follows we propose two story lines, one that looks at EU-Russia cooperation from a more global perspective (2.1) and one from a more European perspective (2.2). Section 3 identifies the main trends and drivers of the scenario. Section 4 provides a synthetic table with impact variables and section 5 a roadmap with the key events and milestones leading to the described output.

STORYLINES

World News / 9 / 2020

Limited bilateral EU-Russia S&T cooperation despite a multipolar global economy

How did we get here?

It is time to look back and look ahead… To understand how the scientific cooperation between EU and Russia has evolved we need to look at the dramatic changes the world has gone through in the past 10 years.

The financial crisis started in 2008 and had a remarkable impact on the real economy, but also on future expectations around the globe.

Today, in 2020, the world comprises many more large economic powers than was previously the case. China, India, Japan, Korea, Malaysia, Indonesia have taken on greater significance in the global economy. China has become the major world exporter and South Asia alone produces 44% of world wealth in these days, compared with 24% eleven years ago. Such a jump forward has put the new Asian economic pole on a par with OECD countries which produce about 40% of world output. Asian competition has also extended more and more to the high-end products and services of the value chain. Robust economic growth in China and India has reshaped the globalisation and world political processes, giving it a more non-Western face, and also transforming the geopolitical landscape over the last ten years. Not only we, in Europe and across the world, consume more Asian goods and receive more Asian investments, but we are more acquainted with the culture (music, cinema and language) than we ever were before. This trend is bound to continue and by 2040 we will experience an increasingly multi-polar global economy, where Asia will increasingly have the global economic and political leadership.
Whilst we have become economically and culturally more integrated, however, the science and innovation landscape has followed a different trend. Scientific and innovative activities, perhaps for their strategic value of they have been constrained within the boundaries of nations or world region. The Asian giants are building up *Ivory Towers* where they put all their efforts to invent better solutions to tackle their societies' challenges. At the same time, the rather stagnating economic developments in Europe and Russia also refrains them from expanding their activities beyond their borders. They concentrate science and technology activities more on their own priority areas, such as nuclear fission and defence in Russia and green energy in Europe.

Furthermore, the economic situation asking for a provident use of the limited resources and the necessity to keep balance with the new world powers prevents them to open up their Science and Technology systems towards new disciplines and research topics. As a consequence, the R&D investment in both Russia and the EU is increasingly concentrated in those sectors where their potential is already visible. As a consequence, fierce competition has emerged in some priority areas, such as nanotechnologies or the IT sector, where Russia has seen a multitude of internationally competitive private companies springing up. It is no surprise, therefore, that the EU and Russia are also constructing their own *Ivory Towers* to safeguard their interests.

In this race for the tallest *Ivory Towers*, human resources do not have to be mobile anymore as skills (and therefore the training) have become more country/region specific. In particular, the past migration flows between the EU and Russia are now only topics for historic research. Russians try to participate on project level in European R&D collaboration programmes where it makes sense for them, but at a rather slow pace. The same can be said about private involvement in public research programmes: where mutual benefits are expected public-private partnerships do result.

Whilst certain international cultural barriers between Russia and the EU have been decreased, some have become sharper. In particular the different managing styles and the lack of policy integration risk to jeopardise the success of (the few) bilateral collaboration projects. Legal issues and IPR discussions pose additional threats because of the strategic importance of the projects. Clearly cross-cultural competencies have gained in importance to overcome these discrepancies.

Nevertheless, convergent technologies comprising biotechnology, nanotechnology, materials technology and information technology could provide a good starting point for renewing cooperation on joint projects between Europe and Russia, as they cover application fields which are of interest to both regions. Apart from nano-apps and integrated energy supply solutions, space research offers once more an opportunity of rapprochement between the two continental neighbours with an important relationship. Will this opportunity overcome the *Ivory Tower*?
Speech of Prof. Olga Rossi upon acceptance of the European honorary prize
for her research on energy policy – 2020

Thank you, thank you very much.

This prize over-exceeds any expectations I could possibly have since I started working on energy issues.

I am nearly 60 years old and I have seen a lot of the world by now …

Europe has changed remarkably since I was working at the JRC-IPTS. In those days we were afraid that Greece would default the Euro making the EU-political project fall apart in a snapshot… Now, after much financial instability, Europe seems to start being back on its track … but globally we are less politically and economically important. We may be more integrated within Europe, but we are also more isolated in comparison to other world regions. Believe it or not, when I started working nearly 30 years ago, this seemed an impossible scenario.

Today, upon accepting my prize, I want to take stock of the events of the past decades, to understand how we got here. Although this political and economic observations, may seem out of place in this gathering of engineers and hard-scientist, I ask you to bear with me, you'll see how the past few years had an incredible impact on science too …

As you know, I owe a lot to Russian scientists, as I finished my PhD I spent several years there working on energy in the National Laboratories in Moscow. Later, during the early stages of my career, I kept working with them through the so-called Framework programmes, until they were interrupted 6 years ago. They were replaced by the “Post-crisis Science Programme”, where Russian scientists could not participate any more. Since then I kept cooperating with Russian labs, but it has become increasingly hard and increasingly uncommon.

Let's go back a few years. The crisis hit: it was 2008. Since then for several years things started going from bad to worse. The European model started losing credibility: too much government spending, too much welfare and too little stability. This combined with financial frenzy and repeated market crashes, caused Europeans to lose their faith in the Euro, in the European Union and in anyone outside their home country. At the same time, neighbouring regions in North Africa and the Middles East also lost trust in their mode of governance and fought hard for more democracy (Arab Spring).

The EU managed to put the strings together; we integrated ourselves better in terms of fiscal policy. In 2012, EU institutions worked hard to tighten the Stability and Growth Pact and slowly but steadily managed to get even the Mediterranean countries to abide by stricter fiscal regulations. Furthermore, much to the surprise of the US, the EU and the EU Member States decided to tackle the crisis following the successful Finnish experience of the early 1990s: R&D and technology were put at the core of the recovery strategy. Both private and public sector adopted a very targeted approach in investing in R&D, focussing on key sectors and priorities relevant at the national or EU level. Now, though the scars of the crisis are still there, there is a bigger sense of identity within the EU, not last because our differences have been reduced since we run a common fiscal policy. The clearest sign of this renewed sense of identity is that the Europe Day on the 9th of May is now a Bank Holiday across all Member States.
Now public debt is under control and corruption and government inefficiency have been reduced. EU countries are slowly getting back to having A+ rating. Financial regulations have also changed dramatically, not last because of the incredible protest that span around the whole world in 2012 and 2013: our savings are safer and we can comfortably ask for mortgages and pay our houses.

Now things are changing and we can start looking at a brighter future, planning investments both as private citizen and as nations. But we cannot forget that we have gone through a tough decade. In trying to fix our economy and social imbalances we had no choice but to become more and more isolated, and to focus on matters inside the EU.

At the same time, some emerging countries, such as China, India (as well as Indonesia and Malaysia), have kept with their high growth rates. Its political influence has also risen spectacularly. Since 2017 we have the first Chinese IMF president and in these days, China is negotiating its entry in the OECD. Furthermore, within a few days we will have our first Indian World Bank president.

It really comes as no surprise that, amidst these enormous changes, scientific cooperation suffered tremendously. As we were focusing on ourselves, struggling for our own survival, scientific cooperation was not really on the priority list of any politician. Let me be clearer: the political will was and still is there … politicians are, at least when asked, in favour of scientific collaboration. However the right instruments to implement such political will have been lacking because national and European governments were busy dealing with the economic crisis and the social unrest that followed.

Indeed, in the past few years, since the closing of the framework programmes in 2014, new policies have been put in place. In the "Post-crisis Science Programme" funding agencies evaluate projects in light of their impact on national (or EU) economies and of their focus on national or EU priority areas… Several unwanted consequences have followed. For instance researchers, forced to think more in terms of national priorities rather than scientific excellence, have become less mobile, something that would have seemed incredible 30 years ago. Furthermore, in an attempt to get out of the crisis, the EU and OECD countries invested heavily in innovation and market oriented research despite the economic stagnation, in a (short-sighted) race for competitive advantage (the well known Technology for Jobs policy package). Last but not least, as countries (or global-regions) have become more closed in themselves, cultural differences have become more acute and are an increasingly important obstacle in scientific and business interaction.

Clearly, such a focus does not encourage scientific collaboration, even with important partner countries such as Russia. At the same time, and for very similar reasons, the interest of other countries to cooperate with Europe has been decreasing. Economically our consumer markets are saturated and scientifically BRIC countries can now offer scientific facilities and skills of equal quality for a lower price. It is no surprise that only occasionally, very well renowned centres have had the opportunity to collaborate – on a bilateral basis – with foreign academies. And I am proud to say that the centre I direct was one of the lucky ones. We fought and struggled to find money and time. At the right moment our Italian government jumped in with its strong support for the bilateral Italian-Russian project on nuclear fusion energy. In addition, the EC had very limited funds for collaborations, in the Science for Excellence programme, which we successfully tapped. So we managed to keep collaborating with the Russian National Research Centres in Moscow and could generate important research results on fusion energy, which led to this prize today. At the same time it is a pity
though that Russia has reduced its participation in the international fusion energy project ITER, to next to nothing.

There are now weak signals that the economy is starting to get back on its track in Europe. We clearly are far from the growth rates of emerging superpowers such as China and India, or fast developing countries like Malaysia, Korea and Indonesia, but again on the level of USA. Yet it seems the appropriate time to start looking at science in a different way.

I have seen enough of the world to know that what seems unchangeable can change. This prize, and the crucial implications for energy and the environment that derive from the work my team and myself conducted, would have not been possible without the exchange of ideas that my lab has kept enjoying despite an environment unfavourable to cooperation.

Bilateral cooperation projects, such as the ones we have been running, are hard work, especially as scientists become increasingly locked in their Ivory tower, yet they are extremely rewarding and it is time to start thinking about facilitating them.
MAIN ARGUMENTS

Framework conditions for scenario

- Not very effective instruments for R&D and innovation collaboration
- Collaboration only on some thematic fields (e.g. space). As priority areas are national interest driven, the agendas do not match:
  - diverging priority areas – e.g. defence, nuclear fission in Russia, green energy in EU
  - competitive priority areas – e.g. nanotechnologies, IT.
- Geopolitics: Russia tries to keep balance between EU and other world powers such as China, middle east, Latin-America, USA, …

Economy, markets, competitiveness, economic development

- A rather stagnating economic development does not inspire Russia to open up its S&T system towards new disciplines and research topics.
- On the contrary, Russia is investing more money where its research and innovation potential is visible.
- R&D investment of private companies has been increasing significantly in Russia, e.g. in the IT sector, where they can expect a remarkable return on investment.

Public versus private actors and sectors, private involvement in S&T

- Private companies participate and are gaining significantly in importance in S&T to pursue their R&D goals aiming at the development of innovative products and services.
- Where they can and expect mutual benefits, private companies engage in public-private partnerships.
- Public actors engage in S&T development where the nation's interests are concerned.

Regulation and standards – regulatory framework, IPR rules, visa, etc.

- No common policy in S&T

Governance and institutional solutions: agreements, institutions

- Governance: project level collaboration with a public private cooperation, or only public with high regulation from both sides

S&T cooperation instruments: funding instruments for R&D and innovation available

- Russian scientists cannot participate any more in the in EU programmes.
- Social sciences and humanities is another field with some R&D collaboration: languages, history, but also migration.

Resources, financial implications

- Rather high investments in R&D and innovation on national (and EU) levels in specific themes, involving significant contributions from the private sector.

Thematic and structural orientation of cooperation

- Joint project could be in space, some parts of nanotech.
- Social sciences and humanities is another field with some R&D collaboration: languages, history, but also migration.

Performance of S&T collaborations

- Where a strong research and innovation potential is given, the performance of (mostly bilateral) S&T collaborations is rather high.
Qualified human resources, migration, demography
  • Limited mobility for scientists between EU and Russia

R&D and innovation infrastructure
  • Quite high R&D investments benefit also the enhancement of R&D and innovation infrastructure especially in the areas of increased national interest.

Cultural issues
  • Cultural differences risk to jeopardise the success of joint projects, because of different managing styles and lack of policy integration
  • Legal issues and IPR discussions pose additional risks, because of the strategic importance of the R&D and innovation projects. It is unclear whether open innovation will be applied in the project.
  • Geopolitics: Russia tries to keep balance between EU and other world powers such as China, middle east, Latin-America, USA, …

Additional factors
  • Quite a low level of trust between EU-Russia, but better than with China, USA, …

IMPACT VARIABLES

<table>
<thead>
<tr>
<th>Impact Variables</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. S&amp;T policy integration</td>
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</tr>
<tr>
<td>2. R&amp;D Policy Investment (high vs low) – regional targets</td>
<td>+</td>
</tr>
<tr>
<td>3. Performance (high vs low)</td>
<td>+</td>
</tr>
<tr>
<td>4. Private involvement (+ vs -)</td>
<td>+/-</td>
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<td>5. Transparent governance (advanced + vs old fashioned-)</td>
<td>+/-</td>
</tr>
<tr>
<td>6. Economic development (+ vs -)</td>
<td>+/-</td>
</tr>
<tr>
<td>7. Cultural proximity (+ vs -)</td>
<td>-</td>
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<tr>
<td>8. Thematic diversity (wide + vs narrow -)</td>
<td>-</td>
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<tr>
<td>9. S&amp;T cooperation instruments (innovative + vs traditional -)</td>
<td>-</td>
</tr>
<tr>
<td>10. Qualified Human Resources</td>
<td>+/-</td>
</tr>
<tr>
<td>11 Regulatory framework</td>
<td>-</td>
</tr>
<tr>
<td>12 Research infrastructure/equipment</td>
<td>+</td>
</tr>
</tbody>
</table>
ROADMAP

Ivory towers - Isolated R&D excellence

- High R&D investment in EU and Russia, but smaller in other countries
- Isolated R&D excellence in EU and Russia
- Only occasional cooperation
- Increased administrative burden and decrease of trust
- Mismatch in research priorities

2012
OECD & EU technology for growth, policy package

2012
Russian R&D programme excellence for economic development

2014
END - FP programmes, EIT - Post-Dissertation programme (focus on national priorities)
EU - New stability & growth pact (final integration)

2017
EU Science for Excellence programme
First Chinese IMF President

2019
First Indian World Bank President
China joins the OECD

2010
Europe hit by financial crisis
Russia keeps balance between EU and other rising powers
Rise of Asian powers

First signs of economic recovery
8.2.4 ERA.Net RUS Foresight Exercise: Scenario 4: Same problems, reORIENTation towards new partners

STORY

17 Dec 2020: Russia Daily News

*Anniversary: 10 years of marching towards nowhere in RDI integration with the EU*

Ten years ago, in 2010, there were hopes for Russia’s full scale integration into the European RTD Framework Programme (then FP7). However – despite of numerous discussions and a lot of preparatory work – an official agreement had not been signed and Russia had to stay in a position of a third country. It is difficult to judge now what the reason of this stagnation was – the high financial contribution that Russia would have had to pay in the common Framework Programme budget or a lack of will from the EU side. Maybe the causes for it have an origin in 2008, when the world was hit by the strongest crisis ever – oil crisis, food crisis, financial crisis, the effects of which had far-reaching consequences through the years that came.

The negative signs of all these events are still evident today, in 2020. This is the last year of the EU’s “Horizon 2020” programme and Russia is still not fully integrated in the European Research and Innovation Area. The limited enthusiasm on the EU side for associating Russia to the Horizon 2020 programme has led Russia to refocus its priorities on the Eurasian Union and to divert significant financial resources to this cooperation. A Eurasian Innovation Fund (EIF) was set up in 2012 and has now an annual budget of €500 million. It supports R&D and innovation projects among researchers and businesses as well as infrastructure projects in Eurasian Union member states. The Fund is driven by the financially strong members Russia and Kazakhstan, and involves also Ukraine with its important researcher community. The support activities of the Fund have been expanding quickly, although its impact is limited by the narrow spectre of innovative companies in the Eurasian Union members. The Eurasian Innovation Centre (EIC) based in Novosibirsk is more of a success story. It has been established since 2013 on the model of the Skolkovo Innovation Centre (close to Moscow) and involves a broad range of international partners, especially business investors from China and India. In 2016, after numerous discussions a large-scale 5-year Russia-China R&D programme was launched. According to the opinion of S&T experts this decision allowed to improve Russia’s R&D positions and opportunities. The next step on Russia’s path towards the East was made in 2017, when an agreement on broad exchange programmes between Russia and the Eurasian Union was reached. So it seems that
Russia is searching alternative ways of integration in the global R&D community under conditions of an uncertain situation in R&D collaboration with the EU.

Today, for an activation of R&D collaboration the EU and Russia still need to build a strategic joint research and innovation agenda, find ways to joint or complementary R&D programmes, and to increase investment in joint R&D projects. There is still a deficiency of sustainable instruments to strengthen the international cooperation policy dialogue, including identification of mutually interesting S&T fields for cooperation, financial tools and strategic directions. Intergovernmental cooperation programmes in R&D practically remained at the same level as ten years ago. In spite of the S&T Agreement between Russia and the EU, there is a wide range of differences in national legislations and administrative regulations which hamper the implementation of trans-national activities. All these gaps are related to factors such as:

- a high level of bureaucracy;
- different competition rules;
- different evaluation criteria, review and reporting procedures for projects;
- incompatibility of funding schemes, of legal and social welfare systems (e.g. unsettled social insurance, pension funds for scientists working abroad);
- no agreement on lifting of visa procedures in spite of decade long debates;
- and finally customs duties and taxes on shipping of materials and equipment complicate scientific work and as consequence influence the attractiveness of one or another country for research.

Moreover, underdeveloped commercialization of R&D results in Russia is a serious threat for the EU-Russia R&D and business collaboration. Problems with attracting investment to Russia remain. They are caused by S&T policy disintegration trends, uncertain guarantees for basic property rights, and an unfavourable investment climate in the R&D area overall. Property rights regulation has been significantly improved over a transition period, but major problems have not been solved yet: a wide range of specific legal rules exists, but the system of regulation and protection of IPR is underdeveloped and ineffective, and the judicial procedure remains intransparent. In spite of significant efforts for increasing the attractiveness of the Russian innovative sector for EU investors, the overall volume of EU investment in Russian R&D and innovation is more than modest.

Although the support at the government level is at a quite high level (for example, Russian SMEs participating in joint programmes receive tax exemption and enjoy favourable credit terms), the improvement of the innovation climate is scattered among certain segments without a high impact on the performance of the National Innovation System in general. Under conditions of stagnation the Government has to limit the support measures to traditional priority sectors (e.g. atomic energy, defence, etc.), without addressing longer-term key grand challenges.

A lack of well-coordinated actions induces a deficiency of high-qualified staff: both the EU and Russia suffer from lasting brain drain: bright talented people continue to prefer the US and China for working and leave for these destinations. Another negative trend concerns brain waste – a lot of people who were initially attracted by an academic career have given up research to embark on a business career, which is due to better salaries and self-realisation
opportunities. The most obvious barriers to mobility of scientists between Russia and the EU include: language, school for children, job for spouse, portability of social security and pension packages, reintegration in the country of origin.

The demographic situation, coupled with the low degree of R&D funding, jeopardizes the existence of some universities in both the EU and Russia. Since 2010 some of them have even been closed down and others have faced a deficit of students. Only few universities focused on technology research remained globally competitive in the EU and in Russia, and the same situation can be observed in respect of research laboratories. Russian universities are still preoccupied with lecturing activities, while R&D in European universities supports mainly business-oriented research, through developing specific curricula to meet the needs of the big industrial players. The demographic risk is multiplied by the continuing low birth rates, resulting in decreasing numbers of graduates and increasing competition for human resources between industry and academia. These factors have led to a decrease of the overall national human potential, in particular of the quality and quantity of staff for innovation and the R&D sector.

Given the above mentioned problems, the convergence of standards (in particular Bologna process) is of great importance for strengthening of both integration processes and innovation performance. The process of convergence has started in 2005, but hasn’t been completed yet. Some improvements have been achieved, however the majority of measures implemented were superficial and did not bring any critical changes: there remain significant differences in educational approaches, the research exchange is still too complex, and discrepancies between requirements for participants in joint programmes and the level of competence of many Russian applicants hamper the cooperation.

A fundamental role in RDI cooperation and integration belongs to SMEs, but many negative trends have become evident during the past 10 years: the enterprise activity decreased significantly, investment in R&D and innovation made by companies fell, and a lack of an own research base in Russia’s business sector is apparent. Due to low returns on investment, companies prefer to avoid investing or invest only limited resources in RDI, whereby the motivation for integration for EU companies has declined as well. However, some Russian organisations partially participate in the Horizon 2020 Programme for RDI, but it is not a widespread occurrence. Participation of Russian SMEs in the EU programmes is quite limited due to the barriers for organisations from third countries.

Cooperation in RDI in the public sector is determined by bilateral agreements in certain areas or on certain research tasks. The number of such agreements has stayed at the same level as in the year 2010. Cooperation between EU and Russian universities did not expand significantly, and the Russian public sector in general is still not open enough for collaboration with EU private companies. Moreover, the Russian private sector doesn’t attract funding from the EU public sector. However, efforts are undertaken by some private firms from the EU and by state-owned Russian corporations to enhance STI integration.

Russia strongly protects its national businesses. It’s still too complicated and contradictory regulatory system for business activities hampers the EU-Russia RDI integration process, because it limits opportunities for joint project implementation. Russia’s accession to the WTO (in 2011) and the OECD (in 2013) have not significantly improved the
business climate in the country. Russian R&D cannot meet the needs of the businesses, this is why the Russian companies are oriented on purchasing more and more turn-key technologies, and cannot rely on the national R&D community.

Russia successfully hosted the Winter Olympic Games (in 2014) and the FIFA World Cup (in 2018), but these events became a heavy burden on the budget, and as a result the volume of investment in R&D fell. Only a few areas of R&D (for example, nanotechnology) kept stable funding. As an exception, defence expenses have risen over the last decade and drew resources away from the civil sector. As the defence sector is quite closed for international research programmes, it did not offer opportunities for increasing the number of RDI cooperation programmes.

The EU and Russia have concluded bilateral agreements, focused on some strategic areas like nanotechnology, nuclear energy and space research. Collaboration in these areas is not completely effective, because related programmes are not open to full participation of researchers. The examples of successful collaboration such as bilateral projects concerning nuclear security could become a base for further integration processes.

Interlinkages with the EU in research infrastructures are developed very slowly, and new infrastructure elements did not appear. External academic mobility, common programmes in the education sphere and joint staff training are implemented according to mechanisms of multi- and bilateral agreements.

There is no comprehensive general policy and RDI agenda, but only some sectoral cooperation between the EU and Russia still exists. In formulation and implementation of RDI policy Russia and the EU are mainly oriented towards national interests, whereas opportunities for collaboration are taken into account as facultative ones.

The current situation of Russia’s R&D and innovation culture may be characterised by a significant degradation of conventional institutes, and a high level of corruption and political lobbying in universities and research organisations. Considerable differences in the innovation culture in the EU and Russia can be observed, for example managerial styles remain quite distinctive.

In 2013, Russia became a member of OECD. This improved Russia’s position in foreign affairs, but it did not have a strong impact on collaboration between Russia and developed countries in RDI. Anyway, the interest for enhancing cooperation in EU-Russia RDI cooperation is still rather high, notwithstanding the unfavourable environment and the shifting of Russia’s R&D connections towards China and other Eastern countries. We hope that a new stage of RDI interactions between Russia and the EU starting in the coming years will be more effective and fruitful.
MAIN ARGUMENTS

Framework conditions
• Shifting of Russia’s RDI cooperation efforts towards the Eurasian Union because of limited enthusiasm of the EU to strengthen cooperation
• Advancement of the EU as a military power slows down EU-Russia S&T cooperation, because of the growing security impact of dual use technologies

Governance, Regulation, Standards
• IPR policy in Russia is still being unsettled
• “dot” solutions for innovation climate improvement cannot make a sufficient impact on the performance of the National Innovation System
• Russia will become a member of OECD
• Underdeveloped commercialization of R&D results in Russia is a serious threat for the EU – Russia R&D business cooperation
• Agreement on the facilitation of scientific visa procedures has not been reached
• Problems of property rights protection in Russia are not completely solved
• Conservation of basic institutions
• Rigid hierarchical organization of policy making
• Continuation of priority support to traditional sectors of the previous technological wave without necessary changes
• Focus on political argumentation in innovative decision-making process limits opportunities for effective decisions from an economic perspective
• Convergence of standards (Bologna process, etc.) was superficial and did not lead to significant improvements
• Economic, social/political and legal risks concerning global challenges
• HORIZON 2020 is more innovation oriented than previous FPs, which does not so much correspond to Russia’s strengths
• The Eurasian Innovation Centre has been established in Novosibirsk

R&D funding
• Financial support to scientific and innovative activities is outdated and very inefficient
• Low return on investment prevents EU MS/AC companies from investment in the Russian R&D sector
• Bilateral agreements between EU and Russian companies & universities were signed, but are not implemented effectively
• Russia became a member of Eurasian Innovation Fund
• Funding types (non-repayable, grant-based type, repayable type) should be improved
• Oil, food and financial crises reduced companies and government opportunities for R&D funding
• Large scale 5-year Russia - China R&D program has been launched

Private sector cooperation
• Decreasing of enterprise activity in Russia
• Absence of competitive environment
• Decreasing investment in R&D and innovation by Russian companies
• Actual existing gap between the current technological status of enterprises and the expectations of the Russian government in respect of their innovative activity
• Lack of own research base in the private sector
existing internal workplace issues that absorb time and distract large amount of financial, staff and administrative resources
level of advantages and benefits of cooperation expected by EU companies tends downwards

**Public sector cooperation**
- cooperation between EU and Russian universities remains at a constant level, there is no significant intensification of collaboration
- slight integration between public and private sectors: Russian public sector is not open for collaboration with EU private companies
- weak collaboration between public and private sectors

**Qualified human resources, migration, demography**
- lack of competent staff for RDI activities
- staff exchanges between the EU and Russia began to weaken
- Agreement on broad exchange programs between Russia and the Eurasian Union
- programmes concerning establishing research groups with EU and Russian qualified human resources are partly blocked

**Infrastructure**
- development of EU – Russia cooperation on large-scale infrastructures stops or declines
- weak contribution of business activities to knowledge generation sector
- bilateral cooperation institutions are not effective and do not play a significant role in strengthening the EU – Russia cooperation in the R&D sector

**Cultural Issues**
- significant degradation of conventional institutes in Russia
- lack of significant international brands in the market of innovation and science in Russia
- level of innovative culture in Russia is lower than in the EU, which leads to some difficulties in interconnections concerning R&D
- globalization of Russian science and its achievements is not so high as it would be necessary for an effective collaboration
- difference of managerial styles
- lack of trust for cooperation

**External Factors**
- highly unstable model for integration of Russia into the world economy
- refocusing of Russia on the Eurasian Union, including RDI cooperation, because of limited enthusiasm of the EU to strengthen cooperation
- the shift of economic, political and scientific power towards Asia, enhancement of BRICS change preferred cooperation directions for Russia
- advancement of the EU as a military power slows down EU-Russia S&T cooperation because of the growing security impact of dual use technologies
- high pressure to address Grand Challenges and as a result of different systemic capacities of the EU and Russia, lack of strategic common interest
- discrepancy between the social-oriented EU S&T policy and Russian hi-tech focused S&T policy
- new financial and economic recession, which will have a different impact on R&D funding in the EU and Russia
## IMPACT VARIABLES

<table>
<thead>
<tr>
<th>Impact Variables</th>
<th>Scores</th>
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<tr>
<td>1. S&amp;T policy integration</td>
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</tr>
<tr>
<td>2. R&amp;D Policy Investment (high vs low)</td>
<td>-</td>
</tr>
<tr>
<td>3. Performance (high vs low)</td>
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<tr>
<td>4. Private involvement (+ vs -)</td>
<td>-</td>
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<tr>
<td>5. Transparent governance (advanced + vs old fashioned -)</td>
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<td>6. Economic development (+ vs -)</td>
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<td>7. Cultural proximity (+ vs-)</td>
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<td>8. Thematic diversity (wide + vs narrow -)</td>
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<tr>
<td>9. S&amp;T cooperation instruments (innovative + vs traditional -)</td>
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<td>10. Qualified Human Resources</td>
<td>+ -</td>
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<td>11. Regulatory framework</td>
<td>-</td>
</tr>
<tr>
<td>12. Research infrastructure/equipment</td>
<td>-</td>
</tr>
</tbody>
</table>
ROADMAP

Same problems, reORIENTATION

| **Funding for R&D declines dramatically, both in Russia and the EU** |
| **Disintegration of EU - Russia S&T policy cooperation** |
| **Decreasing enterprise activity in Russia, declining R&D investment by business sector** |
| **Weakening human resources, less exchanges EU-RU, but brain drain to USA and China** |
| **Refocusing of Russia on Eurasian Union, including R&D cooperation** |

### Milestones

<table>
<thead>
<tr>
<th>2010</th>
<th>2012</th>
<th>2015</th>
<th>2020</th>
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<tbody>
<tr>
<td><strong>Russia is a member of Eurasian Innovation Fund</strong></td>
<td><strong>New Russian president initiates negotiations on full-scale EU-Russia R&amp;D</strong></td>
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<td><strong>2013 Russia joins OECD</strong></td>
<td><strong>2014 Russia is out of the EU's Horizon 2020 prog.</strong></td>
<td></td>
<td><strong>2017 Agreement on broad exchange programs between Russia and Eurasian Union</strong></td>
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<td><strong>The Eurasian Innovation Centre in Novosibirsk</strong></td>
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### Global GEO-Political

<table>
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<th>2014</th>
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<tr>
<td><strong>New wave of world crisis</strong></td>
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<td><strong>Highly unstable situation for integration of Russia into the world economy</strong></td>
</tr>
<tr>
<td><strong>Shift of economic, political and scientific power towards Asia</strong></td>
</tr>
</tbody>
</table>
8.3 Annex 3: DELPHI analysis – full version

8.3.1 Delphi I Analysis – quantitative

ERA.Net RUS
Analysis of Delphi round I

2012
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1 Analysis of the ERA.Net RUS DELPHI round I

The survey was devoted to the identification of key future trends in the cooperation in research, development and innovation (RDI) between Russia, the European Union (EU), its member states (MS) and the associated countries (AC) to the EU’s 7th Framework Programme for RTD (FP7). The survey was planned, developed and implemented by the ERA.Net RUS foresight partners, the Centre for Social Innovation (ZSI, Austria), the Higher School of Economics (HSE, Moscow), the Institute of Prospective Technological Studies (JRC-IPTS, Seville), and the International Centre for Innovations in Science, Technology and Innovations (ICISTE).

1. Questionnaire

The survey questionnaire was developed both in Russian and English languages. Most of questions in both questionnaires were similar, although some of them were different with respect to regional specific issues. In particular, the following questions were not included into the Russian questionnaire:

1) country of residence;
2) desirability of scenarios for the development of RDI in the European Union as a whole;
3) background conditions in the EU.

1.1. Description of the survey

- EU MS/AC experts filled in the English questionnaire.
- Russian respondents were divided into two categories: experts, who filled in the Russian questionnaire and experts, who filled in the English questionnaire (the latter ones were experts, based partly in Russia and the EU).

1.2. Structure of the questionnaire

The questionnaire was structured into five major parts:

1) Introduction
2) Expert information
3) Likelihood of EU-Russia RDI cooperation scenarios
4) Background conditions for EU-Russia RDI cooperation
5) General assessment of EU-Russia RDI cooperation perspectives.

2. Response rate

The survey population consisted of researchers from the EU MS/AC and from Russia involved in active scientific cooperation between the EU and Russia. Furthermore policy makers and other experts involved in EU-Russia RDI cooperation were included in the sample. They were selected from all major fields of science. The number of experts invited to fill in the English questionnaire was 4960, whereby 377 e-mails bounced back and reduced the basis for calculating the response rate. The number of experts invited to fill in the Russian questionnaire was 2354, whereby 96 e-mails returned back (figure 1).

The response rate was calculated as a ratio of the number of experts, who participated in the survey (e) to the number of experts invited to take part in the survey (E):

Response rate = \( \frac{e}{E} \times 100\% \)

- The response rate on the EU MS/AC side was 1224/(4960-377)= 1224/4583 =26.7%
- The response rate in Russia was 348/(2354-96)= 348/2258 =15.4%
- The overall response rate for EU and Russian respondents was (1224+348)/(4583+2258)= 1572/6841 =23%.

---

3 Further on relevant questionnaires are referred to as “the Russian questionnaire” and “the English questionnaire” respectively.
The share of questions answered by an individual respondent was calculated as a ratio of the number of questions answered by a respondent (n) to the total number of questions (N). The relevant indicator for the overall analysed groups of respondents was calculated as an average for each group:

- Average share of questions answered for the English questionnaire = 77.17%
- Average share of questions answered for the Russian questionnaire = 84.89%.

The survey and all relevant calculations were implemented on the basis of the Delphi Online Survey System, a software developed by HSE, Russia.

**FIGURE 1 Response rate**

<table>
<thead>
<tr>
<th>Experts participated</th>
<th>Experts invited</th>
</tr>
</thead>
<tbody>
<tr>
<td>On the EU MS/AC side</td>
<td>1224</td>
</tr>
<tr>
<td>In Russia</td>
<td>348</td>
</tr>
</tbody>
</table>

The response rate

- On the EU MS/AC side: 26.7%
- In Russia: 15.4%

Questions answered

- On the EU MS/AC side: 77.17%
- In Russia: 84.89%

3. Analysis of survey results

The following groups of respondents were identified for the further analysis:

- respondents to the Russian questionnaire — RU;
- respondents to the English questionnaire — EU;
- European researchers responding to the English questionnaire — EU(EU);
- Russian researchers responding to the English questionnaire — EU (RU);
- responses of EU MS/AC contacts — EU(EU);
- all Russian respondents — EU(RU)+RU;
- all respondents — EU+RU.

3.1. Expert information

The distribution of respondents by country showed a lead of Russia (30.21% of respondents), second was Germany (15.43%) and France was third with 11.78% (see figure 2). Respondents came from a broad range of countries, including from all but one EU MS and most of the associated countries to FP7. Based on this distribution, the further analysis was focused on the two major groups of respondents, from the EU (including EU MS/AC) and from Russia.
The experience of respondents was distributed as follows (figure 3):

- Over 80% of all respondents had more than 10 years’ experience.
- The shares for the English and Russian questionnaires (EU vs. RU) were slightly different. Among the respondents to the Russian questionnaire 73.26% had experience of more than 10 years, whereas for the English questionnaire this indicator was higher (84.8%).

These results allow to judge on rather high credibility of the survey information as it was based on the opinions of very qualified experts.

More detailed information concerning the experience of respondents is presented in the Annex.
As for the gender of respondents there were more men than women in the full sample (81.17% male and 18.83% female respondents for EU+RU). The share of women on the Russian side was slightly higher compared to the EU respondents (figure 4).

The respondents’ field of work was distributed as follows (figure 5).

For EU+RU responses there were:
- 65% - natural sciences;
- 21% - engineering and technology fields;
- 7% - medical sciences.
- 4% - from social sciences.

A comparison of the English and Russian questionnaire showed a similar picture for the leading scientific fields, but with a certain difference in the shares of experts:
- major part of European and Russian respondents represented natural sciences (61% and 75% respectively);
24% of European and 14% of Russian respondents were from engineering and technology fields of science;
8% of European and 5% of Russian experts were from medical sciences;
4.4% of European respondents were from social sciences and 3% of Russian experts — from humanities.

The high share of natural sciences can be explained by traditionally predominant role and high level of disciplines such as physics, chemistry, Earth sciences and other natural sciences in the Soviet and then Russian science system, and long traditions of EU-Russia cooperation in these fields.

**FIGURE 5 Distribution of responses by the field of work**

3.2. Likelihood of EU-Russia RDI cooperation scenarios

The DELPHI questionnaire included four scenarios of cooperation between Russia and EU MS/AC countries. The short description of each scenario is presented below.

**Scenario 1 – R&D policy paradise.** In the year 2020 we are looking back at a decade of prosperous cooperation in Research, Development and Innovation (RDI) between the EU and Russia. Russia’s participation as an associated country in the EU’s Horizon 2020 RDI funding programme has proven an unexpected huge success. A free trade zone has been established between the EU and Russia and Russia acceded to the OECD. Surprisingly, business cooperation on RDI has strongly intensified. New RDI cooperation instruments have been successfully established, such as a joint EU-Russia RDI Fund and calls in the frame of an ERA-NET plus project.

**Scenario 2 – Empty cooperation shell.** In this scenario the results of insufficient investment in EU-Russia RDI cooperation are clearly visible. Whilst there is a strong will for RDI cooperation (with a constantly improved governance and innovative cooperation instruments), qualified personnel is lacking. This is partly due to successful Russian private companies, which drain public research centres of key human resources. This is combined with a lack of incentives for private companies to participate in RDI cooperation. As also investment in EU-Russia RDI cooperation is
low and decreasing, no positive influence on scientific and innovation output is generated.

**Scenario 3** – Isolated R&D excellence. In this scenario the world economy is becoming multi-polar, with the Asian economic pole producing ~40% of world output. Economic globalisation is accompanied, perhaps surprisingly, by scientific isolation. Every macro-region (including the EU and Russia) is trying to build up the best Ivory Towers (i.e. centres of excellence) to reach the highest RDI performance in their specialities and to remain competitive. EU-Russia RDI cooperation is fairly limited to specific areas, as there is a certain mismatch in thematic priorities: Russia focuses on nuclear fission and defence, etc. while the EU focuses on green energy, ageing, etc.

**Scenario 4** – Same problems, reORIENTation towards new partners. Because of the EU's limited enthusiasm to strengthen cooperation, Russia has shifted its RDI cooperation efforts towards the Eurasian Union (with Kazakhstan, Ukraine, China, etc.). Russia is in 2020 still in the position of a third country towards the EU RDI funding programme Horizon 2020 and has not been fully associated and integrated in it. In RDI governance several issues remain unsettled such as the Russian IPR policy, the lifting of visa procedures, convergence of standards (Bologna process, etc.), and few more. This has not led to significant improvements in cooperation.

The likelihood (probability) and desirability of EU-Russia RDI cooperation scenarios are described below.

**Questions of the survey considered for each scenario:**

- How likely is the scenario to happen in the coming years (i.e. between now and 2020)?
- How desirable is the scenario for the development of RDI in your country?
- How desirable is the scenario for the development of RDI in the European Union as a whole?

**Scenario 1:**
- half of all respondents estimated this scenario as rather unlikely to happen, whereas just every fourth expert supposed it as rather likely to happen.
- More than 50% of all respondents considered scenario 1 as very desirable for EU-Russia RDI cooperation and more than 40% of respondents assume this scenario as rather desirable (see figure 6).

Therefore the scenario 1, being the most desirable but rather unlikely, can be considered as a “goal scenario” to be targeted by the EU and Russia.
**Scenario 2:**
- half of all respondents indicated that the scenario 2 was rather likely to happen, whereas only 30% of experts disagreed with this.
- More than 60% of all respondents estimated the scenario 2 as rather not desirable for EU-Russia RDI cooperation and around 28% — as very undesirable.

This scenario was considered as more realistic but undesirable. It raises issues of policy measures to be undertaken to prevent dynamics leading to this scenario.

For more information see figure 7.
Scenario 3:
- 45% of all respondents believed that the scenario 3 was rather likely to happen, but every third expert considered it as rather unlikely to happen.
- Almost 60% of all respondents supposed that the scenario 3 was rather not desirable for EU-Russia RDI cooperation and every fourth respondent assumed that it was very undesirable (see figure 8).

Rather big part of experts indicated the scenario 3 as possible. At the same time this scenario was considered by most experts as undesirable. Again there should be implemented policy measures to reduce the probability of realization of this scenario.
**Scenario 4:**
- About half of all respondents assumed that the scenario 4 would rather likely to happen, whereas every third expert thought it would rather unlikely to happen.
- More than 60% of respondents assumed the scenario 4 as rather not desirable for EU-Russia RDI cooperation and one third as very undesirable (see figure 9).

Expert assessments of probability and desirability of the scenario 4 were rather similar to those for the scenario 3.
The analysis shows that expert judgments concerning scenarios 2, 3 and 4 do not differ very much.

3.3. Background conditions for EU-Russia RDI cooperation

The most relevant issues for EU-Russia RDI cooperation are presented in figure 10. According to the overall survey results (EU+RU responses) increasing R&D investment is the key issue for EU-Russia RDI cooperation (684 respondents). Financing has always been highlighted by researchers among the key issues, both in the EU and Russia. Its high importance was confirmed once again in this survey.

Many experts also underlined the importance of availability of financial instruments to support S&T cooperation (499 respondents), as well as training and education of highly qualified RDI personnel (478 respondents). Today the issue of education of highly qualified personnel is very urgent for the economy as a whole. This problem was addressed by a number of recent government documents and programmes in Russia (for example, the Federal targeted programme “Scientific and Scientific-Pedagogical Personnel”\(^4\)) and the EU (programmes of lifelong learning and worldwide exchanges such as Leonardo da Vinci, Erasmus, et al.\(^5\)). Therefore, the survey results confirmed existing trends in this field.

Results of analysis for EU vs. RU questionnaires were mainly the same as for EU+RU respondents. It should however be highlighted that respondents to the Russian questionnaire ranked Involvement of business in RDI cooperation higher than the respondents to the English questionnaire.

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\(^4\) [http://www.kadryedu.ru/](http://www.kadryedu.ru/)

FIGURE 10 (1). Ranking framework conditions
Overall responses to English and Russian questionnaires

FIGURE 10 (2). Ranking framework conditions
English questionnaire
With regard to S&T Policy Integration, analysis of the EU vs. RU questionnaires shows different expectations of respondents (figure 11):

- Almost 60% of respondents to the English questionnaire supposed that S&T policy would rather likely become more integrated.
- As for the Russian questionnaire, the answers to this question were discrepant. About half of respondents believed that S&T policy would rather unlikely become more integrated and over 40% of respondents expressed the opposite opinion.
It should be noted that experts from the EU and Russia had also different opinions about the probability of gross expenditure on R&D (GERD) increase till 2020.

There was a discrepancy in opinions on potential increase of GERD in the EU: some 40% of experts supposed it as rather likely and almost the same share as rather unlikely.

As for GERD increase in Russia, 46% of Russian respondents assumed it as rather unlikely, whereas about half of Europeans supposed it rather likely (see figure 12).

Assessing the future dynamics of GERD involves several uncertainties, since it directly depends on the level of GDP which, in its turn, is difficult to predict due to the recent economic crisis, the volatile and unstable EURO, and other factors.

FIGURE 12 R&D Investment: probability of GERD increase
The prospects of the private sector development in the EU-Russia RDI cooperation are presented in figure 13.

The results show that respondents to the Russian questionnaire were much more sceptic than EU respondents about the future perspectives of private sector RDI cooperation. This in spite of the fact that the RU respondents ranked private sector cooperation between the EU and Russia in the framework conditions (see above) as more important than the respondents to the English questionnaire.

Two thirds of EU respondents thought that an intensification of business sector cooperation between the EU and Russia is likely or very likely. Respondents to the Russian questionnaire (RU respondents) show the opposite trend with 70% classifying it as rather or very unlikely.

As for significant investment increase in RDI by the Russian private sector, the EU respondents were less certain, but still a majority of 57.5% considered it as rather likely or very likely. Again the RU respondents were on the opposite side and 70% assessed a significant investment increase as rather or very unlikely.

These results are striking, considering the EURO Zone troubles as opposed to stronger GDP growth rates in Russia over the last years. EU respondents obviously have more hopes in Russian private sector investment and its cooperation potential, whereas RU respondents seem disillusioned about their private sector RDI involvement. It also indicates that the governments should address these issues in their policies.
Several questions were devoted to human resources development and RDI cooperation perspectives.

The probability of an improvement in RDI cooperation as a result of a convergence of the educational systems was assessed as rather or very likely by 63% of EU experts. In contrast, nearly 70% of RU experts considered it as rather or very unlikely.

As for an expected improvement of RDI-related education in the EU and Russia we have an even more sceptic picture on the Russian side. More than two thirds (67.6%) of EU experts considered it as rather or very unlikely.

Questions of the survey considered in this section:

- How likely is it that the convergence of the educational systems between the EU and Russia (e.g. through the Bologna process: Bachelor-Master-Doctorate) will contribute to an improved RDI cooperation over the coming years (i.e. between now and 2020)?
- How likely is it that the quality of RDI-related education will improve in Russia and the EU between now and 2020 (meaning for Russia in general, not only for specific centres of excellence)?
- How likely is it that the quality of RDI-related education will improve in the EU between now and 2020?
- How likely is an increase in mobility of researchers from the EU to Russia between now and 2020?
- How likely is an increase in mobility of researchers from Russia to the EU between now and 2020?
experts expected an improvement of RDI related education in the EU. They were less certain
about the perspectives in Russia, but still 61.5% rated an improvement as rather or very likely.
However, more than 80% of RU supposed that education quality would rather or very
unlikely be improved in Russia.

Opinions about an increase in researchers’ mobility from the EU to Russia were also
very different for EU and RU respondents. More than half of EU experts said it would
increase (very or rather likely), while 90% of Russian respondents were sceptical about this
(very or rather unlikely). At the same time Russian mobility to the EU was expected to
increase in the future: 88% of EU respondents and 66% of Russian respondents rated it as
rather or very likely.

For more information see figure 14 (1-4).

FIGURE 14 (1) Human resources

FIGURE 14 (2) Human resources
**FIGURE 14 (3) Human resources**
Most of EU respondents estimated a shortage of qualified R&D personnel in the EU as very likely (25%) or rather likely (40%). For Russia their expectations were even significant: very likely (32%) or rather likely (40%). The Russian experts were still more pessimistic about the situation in their country: 90% expected a shortage as very likely (45%) or rather likely (45%). These opinions confirmed existing challenges in S&T policy for both partners. To respond properly to these challenges, S&T policy-makers both in Russia and the EU should reinforce already existing mechanisms facilitating development of human resources in S&T (such as relevant federal programmes in Russia, programmes of lifelong learning in the EU, etc.).

A majority of nearly two thirds of EU respondents evaluated a brain drain of researchers from the public or university sector to business or abroad in the EU as very likely (17%) or rather likely (47%). Their expectations for Russia were more pessimistic: very likely (45%) or rather likely (41%), and Russian experts held the same opinion: very likely (33%) or rather likely (52%). For more details see figure 14 (5-6). As experts agreed on the expectation of a brain drain of researchers from the public or university sector to business or abroad, appropriate policy measures should be undertaken by both partners to ensure a sufficient provision of the public and university sectors with R&D personnel. For example partners can organise EU-Russia programmes for researcher exchange.
FIGURE 14 (5) Human resources

Probability of the qualified R&D personnel shortage

In the EU

English questionnaire

- very likely: 4.67%
- rather likely: 24.67%
- rather unlikely: 40.11%
- very unlikely: 30.54%

In Russia

English questionnaire

- very likely: 3.43%
- rather likely: 31.91%
- rather unlikely: 39.61%
- very unlikely: 25.05%

Russian questionnaire

- very likely: 0.34%
- rather likely: 45.24%
- rather unlikely: 44.56%
- very unlikely: 9.86%
Questions of the survey considered in this section:

- How likely is a refocusing of Russian RDI cooperation to other world regions (e.g. Asia, USA), and away from Europe over the coming years, between now and 2020?
- How likely is a stronger focusing of Russian RDI cooperation on selected EU member states and associated countries to FP7, and away from cooperation with the EU overall between now and 2020?
- How likely is a stronger focus of European RDI cooperation to other world regions (e.g. Asia, USA), and away from Russia between now and 2020?
A clear majority of 75% of EU experts assessed that a stronger focusing of Russian RDI cooperation on selected EU member states and associated countries to FP7 (away from cooperation with the EU overall) as very likely (19%) and rather likely (56%). Russian experts were nearly balanced on this question and only slightly (53%) in favour of a stronger focus on selected EU MS/AC: rather likely (46%) or very likely (7%).

Most of the respondents from the EU MS/AS expected a refocusing of Russian RDI cooperation to other world regions (e.g. Asia, USA), and away from Europe as very likely (19%) or rather likely (54%). Russian researchers, who filled in the English questionnaire were undecided about prospects of such cooperation: rather or very likely (49%) versus rather or very unlikely (51%).

70% of respondents to the English questionnaire estimated that European RDI cooperation will put a stronger focus on other world regions (e.g. Asia, USA), and away from Russia as rather or very likely. Experts from EU MS/AC and from Russia showed a similar response pattern here.

These results revealed a potential decline in importance of EU-Russia RDI cooperation: there is a real chance that Russia and the EU could in the future refocus their research cooperation towards third countries.

For more information see figure 15 (1-3).

**FIGURE 15 (1) Cooperation partners**

<table>
<thead>
<tr>
<th>Probability of stronger focusing of Russian RDI cooperation on selected EU member states and associated countries to FP7, and away from cooperation with the EU</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Diagram showing cooperation partners" /></td>
</tr>
</tbody>
</table>

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FIGURE 15 (2) Cooperation partners

Probability of refocusing of Russian RDI cooperation to other world regions (e.g. Asia, USA), and away from Europe

FIGURE 15 (3) Cooperation partners

Probability of a stronger focus of European RDI cooperation to other world regions (e.g. Asia, USA), and away from Russia
Questions of the survey considered in this section:

- How likely is a deterioration of research infrastructure in the EU due to under-investment, between now and 2020?
- How likely is a deterioration of research infrastructure in Russia due to under-investment, between now and 2020?

The assessment of the probability of research infrastructure deterioration in Russia and in the EU due to under-investment is presented in figure 16.

Europeans were more pessimistic about their research infrastructures than Russians: 57% of respondents from the EU MS/AC assessed a deterioration of research infrastructure in the EU as rather or very likely. At the same time also 57% of Russian experts, who filled in the English questionnaire assessed such deterioration as rather or very unlikely.

Overall, respondents are more sceptic about research infrastructure in Russia than in the EU: two thirds of respondents to the English questionnaire evaluated the potential of a deterioration of research infrastructure in Russia as very likely (27%) or rather likely (40%). Experts from the EU MS/AC and from Russia had a similar opinion on this issue, as opposed to their opinion on research infrastructure in the EU.

The situation with the research infrastructure both in the EU and Russia was not very promising. For the EU there were some signs of deterioration but in Russia the situation was even worse. It indicated that policy measures for research infrastructure improvement should be considered.
FIGURE 16 (1) Research infrastructure

Probability of a deterioration of research infrastructure due to under-investment

<table>
<thead>
<tr>
<th>In the EU</th>
<th>English questionnaire</th>
<th>European researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.03%</td>
<td>19.16%</td>
<td>6.81%</td>
</tr>
<tr>
<td>37.66%</td>
<td>36.15%</td>
<td>20.07%</td>
</tr>
</tbody>
</table>

Russian researchers filled in the English questionnaire

| 9.20%     | 32.18%               |
| 48.28%    | 10.34%               |
Opinions of Russian and EU respondents about the EU-Russian RDI cooperation improvement by means of Russian integration in international economic cooperation forums (WTO, OECD) were different. Most of the EU experts assessed such an improvement as very likely (20%) or rather likely (59%). There was, however, no consensus among Russian researchers on this issue: rather likely (43%) versus rather unlikely (47%).
As for a stronger global coordination of Intellectual Property Rights (IPR) policies (including patent policy), EU respondents estimated it as rather likely (47%) and very likely (17%). Russian respondents in general agreed: rather likely (57%) and very likely (8%).

A high percentage of EU experts estimated an improvement in IPR regulation in the EU as very likely (20%) or rather likely (58%). The future of IPR regulation in Russia was more unclear for both EU and Russian respondents: rather likely (43% for both EU and Russian respondents) or rather unlikely (39% and 44% respectively). For details see figure 17 (1-2).

The survey showed that international R&D Governance on the EU side is likely to be improved, whereas it was much more vague for Russia.

FIGURE 17 (1) International R&D Governance
FIGURE 17(2) International R&D Governance

Probability of improvement in IPR regulation

In the EU

English questionnaire

Very likely: 1.64%
Rather likely: 20.20%
Rather unlikely: 19.76%
Very unlikely: 58.41%

Questions of the survey considered in this section:

- How likely is it that Russia and the EU align their thematic priorities for RDI between now and 2020 (e.g. joint investment in priority areas of mutual interest)?
- How likely is it that, between now and 2020, Russia concentrates on its national RDI priority areas (e.g. nuclear fission, defence research, etc.) to the disadvantage of cooperation with the EU?
- How likely is it that, between now and 2020, the EU concentrates on its RDI priority areas (e.g. alternative energies, ageing society, etc.) to the disadvantage of cooperation with Russia?
The expectations of EU and Russian experts regarding the alignment of Russian and EU thematic priorities for RDI were different (figure 18). The share of EU respondents, who estimated this process as rather or very likely was 58% whereas this indicator for Russia was only 38%. The orientation on the thematic priority alignment was therefore stronger on the EU side.

As regards partners’ concentration on their national RDI priority areas, opinions of EU and Russian respondents showed a similar trend: rather or very likely (64% and 74% respectively).

Coordination of S&T research priorities creates additional opportunities for both partners: it increases global competitiveness, technology level, etc. On the contrary, concentration on the national priorities instead of priorities’ alignment can lead to lagging behind the global leaders in fast developing areas. Therefore this is another issue for attention of policy makers.
3.4. General assessment of EU-Russia RDI cooperation perspectives

Questions of the survey considered in this section:

- How strongly, in your opinion, is the idea of RDI cooperation between the EU and Russia supported by the scientific community in your country?
- How strongly, in your opinion, is the idea of RDI cooperation between the EU and Russia supported by policy makers (representatives of ministries of science/research/innovation and of RDI funding organisations) in your country?

This section illustrates a general assessment of EU-Russia RDI cooperation perspectives by the scientific community and policy makers (figure 19).
Both the EU and Russian respondents supposed that the idea of RDI cooperation between the EU and Russia would be very or rather strongly supported by the scientific community (68% and 81% respectively).

The opinion of the respondents about the policy makers’ support of RDI cooperation was different. While about half of EU experts expected that this idea would be weakly or very weakly supported (53%), 80% of Russian respondents voted for weakly or very weakly supported.

Expert opinions illustrated that cooperation could be restrained by a lack of support by policy makers from the EU and Russia. The issues analysed above demonstrated that several fields of RDI cooperation suffer from a certain lack of appropriate policy measures. The results of this section confirm the conclusions made before. Appropriate actions for promoting the idea of RDI cooperation among policy makers should therefore be undertaken. Moreover, policy makers should take into consideration researchers’ recommendations on the design of the R&D system in the process of its future development.

FIGURE 19 General assessment of EU-Russia RDI cooperation perspectives
8.3.2 Delphi I Analysis – qualitative, open questions

Analysis of the Open Questions (EU MS/AC Side) – DRAFT

With regard to open questions, it should be noted that it was not obligatory for experts to answer them. The questionnaire consisted of three questions in the framework of which the respondents had a chance to comment and explain on the following: their decision for the specific Scenario (response rate: 12.58%), their opinion or comments with regard to the EU-Russia RDI cooperation (response rate: 15.03%), and overall comments regarding their choices, or on specific questions regarding the framework conditions (response rate: 6.5%). The response rate (EU MS/AC side) to all the three open questions has been 11.38%.

Scenarios of the RDI Cooperation Development

Scenario 1: R&D policy paradise

Our analysis shows that more than half of the respondents think that this scenario, which would bring benefits to EU and Russian side, is very desirable but rather unlikely to happen.

"Scenario 1 would be ideal, but unfortunately, it is the least likely option."
"Scenario 1 could become more likely, if there is political will at EU side."
"...common interest is pushing for Scenario 1."
"Ideally the EU would invest heavily in cooperation between Russia and the EU, but I do not see this happening. The key to obtaining scenario 1 is the interest of the EU."

According to our analysis of the respondents’ additional comments, the obstacles preventing this scenario to happen are: bureaucratic and administrative issues from both sides (EU and Russia) (e.g. visa regime) decreasing the level of the mobility, funding issues (e.g. funding of the common cooperation programmes), and different levels of the RDI development.

"... but cooperation will be made difficult by administrative issues and corruption that are not likely to be resolved soon.
"Scenario 1 would be very desirable but rather unlikely due to insufficient funding of research both in Russia and EU."
"I believe that the main problem remains is a visa procedure..."

Scenario 2: Empty cooperation shell

Most of the respondents saw scenario 2 as not desirable but the most probable to happen.

"...lack of funding of public research to effectively participate in cooperation."
"... Scenario 2 is the most probable one. Unfortunately it assumes stagnation..."

The respondents mentioned three reasons which could influence this scenario to happen: lack of funding of the research, administrative issues (visas), and funding.

"... but cooperation will be made difficult by administrative issues and corruption that are not likely to be resolved soon."
"I think science will either lack funding in 2020 (because of lower public R&D budgets as an effect of economic problems) or will be increasingly seen as highly relevant for a region's competitiveness."

Besides the reasons mentioned above, some of the surveyed experts expressed also that the cooperation would take place, but within budgetary and subjects limits and that the bilateral agreements would become more relevant if Scenario 2 happened.

Scenario 3: Isolated R&D excellence
This scenario was rated as rather likely to happen and as rather not desirable/very undesirable.

"It seems to me scenario 3 is the most likely to happen, whether I like it or not."
"...the cooperation on isolated topics."

From the experts’ general comments it could be concluded that this scenario would be realistic if there was a negative development in the EU - Russian RDI cooperation. Some experts think that under this scenario only some of the research areas will be developed.

**Scenario 4: Same problems, reORIENTation towards new partners**

This cooperation scenario was rated as likely to happen, but as not desirable by most of the experts. The comments to scenario 4 vary, some of the respondents are of the opinion that the cooperation will be developed in both (EU and also China) directions simultaneously, while others think that the cooperation between the EU and Russia should be strengthened so that this scenario does not happen.

"Scenario 4 could be expected if actions are not reasonably addressed."
"EU must find a reasonable balance of cooperation with Russia, China and other growing countries."

It should be noted that some of the respondents, who commented their selection of the scenarios, think that at the end the combination of Scenario 3+4 is also an option which is likely to happen.

"It should be noted that scenarios 3 and 4, which I have labelled "very likely" and "rather likely" respectively, are not mutually exclusive. In fact, I believe that a combination of these two scenarios is the most likely development until 2020."
"Scenarios 3 & 4 are very likely. This is exactly the current trend as I see it."

Overall it should be pointed out that the closer look to the comments provided by the experts reveals that the majority of them gave only very general comments on their decision and choice for the specific scenario, without explaining their answers.

"2 is a failed 1, similar 4 and 3. Choice between 1 and 3 is decided in context of global world economy and does not depend on EU and/or Russia."
"I find a hybrid of scenarios 3 and 4 most likely, although scenario 1 is the most desirable and is worth being set as a goal."
"It is rather likely that elements from different scenarios become true ... it is likely that specific RDI cooperation instruments will be developed, whereas other problems will remain (standards, lack of private investments)."
"The scenarios may be difficult to forecast, and this also depends on respective economic trends. In any case, there is room for greater cooperation and mutual benefits."

Our analysis has shown that the surveyed experts, who gave additional comments on the scenarios, think that there will be a combination of the different elements of the scenarios.

**Thematic Priorities**

Some of the surveyed experts think that it would be important to put a special focus on some research areas in the future collaborations. Some of them stressed that deepening of the mutual interests/benefits is very important for further cooperation.

"Strong collaboration is necessary between EU & Russia. Best appears creation of common fund investing 50/50 in R&D between new members of EU and Russia."
"...diversity of areas is important, however some topics we have to focus on: e.g. energy, water management."
"Russian and EU concentrates on its RDI priority areas could reinforce both in some extent."
"Lack of opportunities and funding for collaborative projects with Russia does not advance research. Both sides will benefit from greater funding as well as making joint work a priority."
Many points remain uncertain, since Russian R&D policy for coming years is still under construction.

The majority of the respondents did not comment on the thematic priorities but pointed out some obstacles they saw in the cooperation with Russia, the first issue being the importance of the funding availability from both the sides in the future through the S&T policy dialogue between EU and Russia. Some of the experts mentioned also a lack of opportunities for the collaborative research projects.

Lack of opportunities and funding for collaborative projects with Russia does not advance research. Both sides will benefit from greater funding as well as making joint work a priority. ”

“Allocation of the sufficient funding resources is crucial on both sides, in EU and in Russia.”

“Best appears creation of common fund investing 50/50 in R&D between new members of EU and Russia.”

“More exchange of young scientists, extra funds for short and medium length visits for Russian young scientists in EU”

Another important issue for the respondents is the mobility of researchers and the obstacles which prevent the mobility (e.g. visa regime on both sides). They think that finding solutions to this would allow straightening of cooperation in the future. The bureaucratic obstacles on the EU side and corruption with funds’ allocation on the Russian side have also been mentioned; moreover also the intellectual property and customs issues have been stated.

The main problems in cooperation with Russian partners are... travel restrictions (visa), customs (it is very difficult to send equipment to Russia and back)!”

“A new policy of intellectual property distribution should be developed.”

Ranking of Framework Conditions:

The additional comments received could be divided into four groups:

- **Availability of instruments for supporting the S&T cooperation:** for most of the respondents the sustainable funding of the collaborative project is very important (also funding of the follow-up projects). Allocation of the sufficient funding resources should be crucial on both sides, in EU and in Russia.

- **Finding solutions through policy dialogue to the above-mentioned obstacles,** e.g. visa regime on both sides; bureaucracy on EU side and corruption with funds’ allocation on the Russian side; intellectual property and customs issues have been mentioned several times by respondents.

- **Development of the world economy:** current weakness of world economy multiplied by human factor and poor intellectual property models will be the basic obstacle both in EU-Russia R&D cooperation and in R&D development of individual countries in the next years. Furthermore, some of them think that the investments into RDI and education should increase.

- **Involvement of business in RDI cooperation:** the involvement of businesses in RDI cooperation is the most important topic for some respondents.

**General Assessment of Russia – EU RDI Cooperation Perspectives**

To summarise, it should be highlighted that the majority of surveyed experts, who gave additional comments, welcomed any increase/improvement in the EU MS/AC – Russia Cooperation. It was largely observed from their comments that in addition to the above-mentioned factors also other aspects like political will on both sides, suitable solutions for the administrative and bureaucratic obstacles (e.g. visa issues) preventing the increase of the researchers’ mobility on both sides, corruption with funds’ allocation on Russian side,
sustainable funding issues, would have a great impact on further RDI cooperation. Some of the respondents felt that also the involvement of businesses in the RDI cooperation in future was one of the very important topics for the future to be discussed. These problems warrant proper and relevant solutions that would benefit all the sides involved and consequently deepen and strengthen RDI cooperation among them.

**Comments and suggestions to improve the questionnaire**
- Lack of “neutral” opinion in the likert-scale

> “I would have preferred more differentiation between rather likely and rather unlikely.”
> “Difficult to choose from amongst the four standard answers.”

**Analysis of open questions (Russian side - HSE)**

**Scenarios of RDI cooperation development**

The absolute majority of the experts noted that the situation would probably develop negatively. The pessimistic forecasts mainly concerned Russia, but some of the surveyed believed that the global development trends were negative on the whole.

A closer look at the experts’ views on the likelihood of the four scenarios of Russia-EU research, development and innovation (RDI) cooperation leads to the following results.

- **Scenario 1: R&D policy paradise.** Most of the experts believed this would be the most favourable option which would bring obvious benefits to the Russian RDI community: cooperation would promote application of transparent funding mechanisms in Russia and emergence of competent expert panels; foreign colleagues’ experience would contribute to development of the country’s science. However, due to a number of reasons this scenario seems rather unlikely. First, according to the experts, to be able to talk about cooperation at all, the levels of the Western and Russian RDI spheres should be compatible. But currently it’s not the case: the European RDI sphere is by an order of magnitude more developed than the Russian one. Developing cooperation now without planning and making necessary changes in the future, could turn Russia into a “brain appendage” of the West; also it would make our country extremely dependent on foreign research. Secondly, the EU imposes numerous limitations on Russia, which hinder integration of our RDI communities. These include visas, various customs duties, etc. Thirdly, according to some of the experts, the EU itself is not homogenous and periodically experiences instability, which also hampers cooperation. Fourthly, the current situation in Russia isn’t favourable to development of cooperation: all experts assessed the government S&T and innovation policy as doubtful at the very least, and being contrary to the RDI community’s interests.

- **Scenario 2: Empty cooperation shell.** Most of the experts saw this scenario as undesirable, but the most likely to happen out of all suggested options. Among the factors increasing its likelihood the surveyed experts mentioned the following: excessive corruption in Russia; officials’ insufficient awareness of the real needs of the RDI community; and, according to practically all respondents, insufficient funding of research in Russia (both compared with the EU, and in terms of the absolute amount of investments). Another thing should also be mentioned about the funding: the government only finances “trendy” research areas while basic research is forgotten; so if there’s going to be any cooperation at all, it will happen in these areas, and in the spheres of mutual interest.

- **Scenario 3: Isolated R&D excellence.** The respondents’ opinions regarding the third cooperation scenario differed. If the majority of the experts positively assessed the first scenario and had negative opinion about the second one, the third option was seen
as “neutrally negative” or “neutrally positive”. Some of the respondents believed that in addition to cooperation with the EU countries, Russia should definitely promote links with other RDI centres; others thought that healthy, robust competition was needed in this sphere, without which development would be impossible (the neutrally positive development). At the same time scenario 3 wasn’t deemed to be particularly desirable either, due to a number of reasons. Firstly, without integration into the global RDI communities, the future of our science seems to be quite vague and illusory; secondly, under this scenario only the trendy research areas are likely to develop, but not basic research in general – which would unquestionably harm the fragile Russian research system (the neutrally negative development). As to this scenario’s likelihood, the experts’ opinions also differed; generally, they believed it to be realistic.

- **Scenario 4: Same problems, reORIENTation towards new partners.** Comments on the fourth cooperation scenario differ in terms of China’s potential as Russia’s partner in RDI dialogue. Some of the experts believed integration with the Chinese RDI community would be undesirable due to different culture and mentality, and also due to the quite popular belief that China sees Russia as the communist power’s northern resource appendage. Others expressed positive opinions, because links with China are currently quite good, and anyway they wouldn’t hamper further development of cooperation with the EU. Note that some of the experts believed that option 1+4 would be one of the best possible scenarios for Russia – i.e. simultaneous development of cooperation with the EU and Asian countries.

Speaking about the scenarios generally, the experts believed their likelihood in most cases could be assessed as follows: the scenario’s desirability is inversely proportional to practical opportunities for its implementation. Some of the experts also noted that none of the scenarios would be possible until the Russian RDI sphere becomes interesting to foreign partners – i.e. until it acquires equal knowledge potential. It was also noted that the scenarios’ likelihood was totally dependent on the current and future government RDI policy. If the situation in the sector improves due to reforms or other actions, the likelihood of the most favourable scenario would increase. However, according to about half of the experts, under the current circumstances the EU is not sufficiently interested in developing RDI cooperation.

**Thematic priorities for the Russia-EU cooperation**

Speaking about the chances to integrate the S&T policies, the experts believed they were quite good.

As to investments into R&D, the absolute majority of the experts were pessimistic: without adequate funding, integration – or indeed high-quality research – would be out of the question. According to the respondents, investments were the foundation which could promote development of Russian RDI, and therefore integration of the Russian research community into the global one. Investments are vital for the Russian RDI sphere; the level of monetary investments must be brought up the European one. Another necessary condition is funding absolutely all areas of research, not just the trendy and priority ones. The experts pointed out that without basic research (which is currently not at its best, to say the least, due to the S&T policy the government pursues), Russia’s emergence as a major RDI centre seems very unlikely. At the same time some of the experts noted that the level of investments doesn’t always mean the money is used adequately, so monetary appropriations must be accompanied by a sensible policy.
According to the respondents, the private sector’s role as the main driving force looks somewhat doubtful, because its interest is not in developing basic research but only specific thematic areas, and generating quick profits. At the same time, as an additional source of investments it seems to be very promising.

A lot of words were said about the role of human resources in the Russia-EU RDI cooperation. All experts noted importance of personnel for development of RDI and cooperation in this area; however, they assessed the current Russian situation as extremely unfavourable. To increase the likelihood of successful cooperation with the Western and then with the global research communities, numerous reforms must be implemented and other steps taken to improve the situation: Russian researchers’ (and indeed Russian science’s) status is quite low; RDI personnel’s salaries are much smaller than abroad, so young people have very weak motivation to work in the RDI sphere. Accordingly, young scientists who did choose this path don’t see any future for themselves and their projects in Russia – which leads to significant brain drain to foreign countries.

A serious problem is the existing visa regime between the EU countries and Russia. The experts believe the mobility level isn’t sufficiently high. The need to obtain visas hampers young and established scientists’ ability to attend international conferences and meetings, which negatively affects their training and competence. Difficulties associated with inviting European scientists to Russia also present a problem. Customs duties hinder upgrading of research equipment, get in the way of scientific development and conducting experiments.

According to the surveyed experts, partnership and governance of the two sides’ cooperation are not on a sufficiently high level. Russia-EU cooperation must be extended, and this involves administrative measures because currently most of the joint projects become possible only thanks to direct links and connections in certain circles. In addition to general lack of regulatory provisions for research and RDI cooperation, Russian legislation doesn’t define innovation-based development actors sufficiently clearly. Particular concern cause customs rules and common bureaucracy. Simplified customs rules would help to upgrade S&T equipment, which, according to many experts, is by now quite obsolete and hinders researchers’ work. As to Bologna process, generally it won’t affect cooperation at all since changing scientific degrees doesn’t play an important role in RDI cooperation. However, according to some of the experts introduction of the European system would destroy the already fragile Russian research system, so it would make more sense to keep the Russian system of qualifications.

The experts didn’t say much about thematic priorities. According to them, mutual interests determine success of cooperation, but it seems unlikely that by 2020 an absolute majority of research topics and fields would become high-priority for the both sides. That would depend on the level of RDI development (only equal research partners can possibly have common interests), and on the areas identified in Russia as priority ones (which currently are very clearly limited).

**Ranking of framework conditions**

- S&T policy integration between Russia and the EU: against the background of the major problems the Russian RDI sphere faces (insufficient funding, low prestige of researchers, etc.), this seems to be a rather secondary factor. About one third of the respondents believe that before starting any sort of integration we should build a strong foundation for our own system.

- Integration of Russia into global economic frameworks (e.g. OECD, WTO): only two of the experts have mentioned international organisations in their comments; the OECD was given a higher priority than the WTO. Still, because there were so few mentions, this factor doesn’t seem to be important.
• Increasing RDI investments: according to the experts, it’s the most important factor of all; without adequate investments the Russian RDI sphere won’t be able to compete at all.
• Involvement of businesses in RDI cooperation: it was noted that research groups are quite interested in such cooperation. Also, since the government policy indicates low awareness of real needs and requirements of the Russian RDI sphere, various businesses should get involved in this cooperation.
• Governance of RDI cooperation: a certain number of experts believe it’s a necessary condition. Without a favourable visa regime and simplified customs regulations, cooperation seems to be a very difficult task.
• Development of the world economy over the years up to 2020: due to unpredictable political situation both in Russia and the EU, and the uncertainty regarding the future development level of the Russian RDI sphere, this factor hasn’t been mentioned by the experts at all.
• Cultural issues: practically haven’t been taken into account regarding cooperation with the EU; have been given a relatively high importance regarding cooperation with Asian countries (importantly, they were seen as a negative factor).
• Diversity of thematic areas covered in Russia-EU RDI cooperation: diversity was seen as the main factor determining the future of the Russian RDI sphere, since development of only trendy areas (mainly connected with mining energy resources) seems to be disastrous to Russian science generally; so it’s an important factor for developing cooperation too.
• Availability of instruments for support of S&T cooperation: this is a very controversial issue because currently the EU is not interested in funding Russian projects, while Russian funding for the EU projects is envisioned. Apart from funding international projects, investments into Russian projects should certainly be encouraged, and that needs reliable and transparent tools.
• Training and education of highly qualified RDI personnel: this is one of the high-priority factors, since young people’s lack of interest to research careers and the brain drain abroad create a very acute shortage of skilled personnel.
• Investment in research infrastructure and equipment: another one of the most important factors; obsolete equipment combined with incompetent staff doesn’t allow to develop the RDI sphere adequately.

General assessment of Russia-EU RDI cooperation perspectives
To summarise, it should be noted that generally, to most of the experts Russia-EU RDI cooperation prospects seem to be rather illusory – because the level of the Russian RDI sphere, to put it mildly, doesn’t match the European level. Largely it’s the fault of a poor education policy, when the quality of training deteriorated at every stage from secondary schools to universities. Insufficient investments also hinder development of the RDI sphere, at the relevant stage. The need for cooperation is obvious to the research community, but the policy in this field, according to the survey results, frequently contradicts and hampers adequate integration of RDI communities. Accordingly, the main problems hindering development of Russia-EU cooperation are inappropriate policy; corruption (funds allocated for development of the RDI sphere do not reach their destination); bureaucracy (a vast number of documents have to be prepared to obtain a research grant or acquire equipment); and lack of priority areas for research. Until these problems are solved, the prospects of Russian-European RDI cooperation don’t look to the experts very promising at all.

Comments and suggestions to improve the questionnaire
• Questions and scenarios include biased wording
• It takes more than 20 minutes to make comments
• Some of the scenarios are polar opposites and seem to be utopian; in real life things are more vague
• It would be helpful to have questions not just about Russia-EU RDI cooperation, but more general ones about the overall state and prospects of Russian education, science and innovation spheres.
• Possible development scenarios must be translated into English.
• The study is relevant. Maybe it would make sense to suggest more detailed areas for technical cooperation.
• It would make sense to ask questions answers to which could be grouped as “very desirable”, “desirable”, “undesirable”, “very undesirable” etc., as opposed to “likely” and “unlikely”.
• An in-between option “average likelihood” is required.
• The goal of this study is unclear; who is going to make use of the results, and in what way?
8.3.3 Delphi II Analysis

ERA.Net RUS
Analysis of Delphi round II

2013
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1 Introduction

The ERA.Net RUS project was officially launched in Vienna on 11-12 February 2009 and will last until the end of January 2014. The project comprises 20 partners from 9 different EU Member States and European countries and 6 Russian partners.

The ERA.Net RUS project is focused on synchronisation of the EU and Russian research programmes and activities by defining a more common and ambitious research agenda through a joint decision-shaping process. The project is in line with the overall trend of moving towards a partnership between equals, based on sharing funds and responsibilities. The ERA.Net RUS activities will contribute to the success of the European Research Area by improving the coherence and coordination across Europe of international S&T Cooperation programmes.

The overall DELPHI survey was devoted to the identification of key future trends in the cooperation in research, development and innovation (RDI) between Russia, the European Union (EU), its member states (MS) and the associated countries (AC) to the EU’s 7th Framework Programme for RTD (FP7). The survey was planned, developed and implemented by the ERA.Net RUS foresight partners, the Centre for Social Innovation (ZSI, Austria), the Higher School of Economics (HSE, Moscow), the Institute of Prospective Technological Studies (JRC-IPTS, Seville), and the International Centre for Innovations in Science, Technology and Innovations (ICISTE).

The survey was conducted in two rounds.

The first round of DELPHI was focused on the identification of scenarios and framework conditions of RDI cooperation between Russia and EU MS/AC in the time perspective up to 2020. The key results of the first round were the following:

- Among the four assessed scenarios “R&D policy paradise” (scenario 1), being the most desirable but rather unlikely, was considered as a “goal scenario” to be targeted by the EU and Russia.
- Increasing R&D investment was identified as the key issue for EU-Russia RDI cooperation (around 10% of respondents). Many experts also underlined the importance of availability of financial instruments to support S&T cooperation (about 7% of respondents), as well as training and education of highly qualified RDI personnel (6.9% of respondents).

The detailed analysis of the second round of DELPHI is presented below.

2 Analysis of the ERA.Net RUS DELPHI round II

The identification of the overall frameworks for the EU-Russia RDI cooperation addressed within the first round was complemented by the detection of social challenges and thematic fields of the EU-Russian RDI cooperation in the second round. Moreover during the second round the several issues regarding the framework conditions for the EU-Russia RDI cooperation were specified (cost categories, which should in particular be increased; mobility of researchers; intellectual property).

Description of the survey

The overall sample of experts invited to fill in the DELPHI round II questionnaire was mainly the same as in the DELPHI round I.

The survey questionnaire was developed both in Russian and English languages.6

Response rate. The number of experts invited to fill in the English questionnaire was 4580, whereby 172 e-mails bounced back and reduced the basis for calculating the response rate. The number of experts invited to fill in the Russian questionnaire was 2396, whereby 112 e-mails returned back.

---

6 Further on relevant questionnaires are referred to as “the Russian questionnaire” and “the English questionnaire” respectively.
The response rate was calculated as a ratio of the number of experts, who filled in the survey questionnaire (e), to the number of experts which received the invitation to take part in the survey (E):

\[ \text{Response rate} = \left( \frac{e}{E} \right) \times 100\% \]

- The response rate on the EU MS/AC side was \( \frac{577}{(4580-172)} = \frac{577}{4408} = 13.09\% \)
- The response rate in Russia was \( \frac{410}{(2396-112)} = \frac{410}{2287} = 17.93\% \)
- The overall response rate for EU and Russian respondents was \( \frac{(577+410)}{(4408+2287)} = \frac{987}{6695} = 14.74\% \)
2.1 Expert information

The distribution of respondents by country was rather uneven (see figure 1), with a lead of Russia (48.33% of respondents) and Germany (11.67%); France was third with 7.92%. Basing on this distribution further analysis was focused on the two major groups of respondents: the EU and Russia.

FIGURE 18 Distribution of responses by country of residence

The distribution of respondents by institution (see figure 2) presented the lead of non-university research organisations among Russian respondents (about 60%) and university and higher education institutions among European respondents (around 63%).
Experience of respondents was distributed as follows (figure 3):

- Over 80% of all respondents had more than 10 years experience.
- These shares for the English and Russian questionnaires (EU vs. RU) were slightly different. Among the respondents to the Russian questionnaire 87.2% work in profession more than 10 years, whereas for the English questionnaire this indicator was lower (71.8%).

Such results allow to judge on rather high credibility of the survey information as it was based on the opinions of very qualified experts.

As for the gender of respondents there were more men than women in the full sample (82.3% male and 17.7% female respondents). The share of women on the Russian side was slightly higher compared to the EU respondents (figure 20).
The respondents’ field of work was distributed as follows (figure 21).

For EU+RU responses there were:
- 666 - natural sciences;
- 190 - engineering and technology fields;
- 72 - medical sciences.
- 41 - from social sciences.

Comparison of the English and Russian questionnaire showed a similar picture:
- major part of European and Russian respondents represented natural sciences (340 and 326 respectively);
- 130 European and 60 Russian respondents were from engineering and technology fields of science;
- 54 European and 18 Russian experts were from medical sciences;
- 31 European respondents were from social sciences and 11 Russian experts — from humanities.

The high share of natural sciences can be explained by traditionally predominant role and high level of such disciplines as physics, chemistry, Earth sciences and other natural sciences in the Soviet and then Russian science system, and long traditions of EU-Russia cooperation in these fields.
Figure 22 Distribution of responses by the field of work
Overall responses to English and Russian questionnaires

<table>
<thead>
<tr>
<th>Field of Work</th>
<th>Russian Questionnaire</th>
<th>English Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural sciences</td>
<td>326</td>
<td>340</td>
</tr>
<tr>
<td>Engineering and technology</td>
<td>60</td>
<td>130</td>
</tr>
<tr>
<td>Medical sciences</td>
<td>18</td>
<td>54</td>
</tr>
<tr>
<td>Social sciences</td>
<td>11</td>
<td>31</td>
</tr>
<tr>
<td>Humanities</td>
<td>4</td>
<td>11</td>
</tr>
<tr>
<td>Agricultural sciences</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>
2.2 Societal challenges

Question of the survey considered in this section:
Which societal challenges should be addressed in the EU-Russia RDI cooperation between now and 2025?

Among the societal challenges for the EU-Russia RDI cooperation (see figure 6) the most important ones according to experts were the following:

1) Health, demographic change and wellbeing (55.19% — the Russian questionnaire; 45.12% — the English questionnaire).
2) Secure, clean and efficient energy (20.02% — the Russian questionnaire; 25.46% — the English questionnaire).
3) Climate action, resource efficiency and raw materials (10.85% — the Russian questionnaire; 13.80% — the English questionnaire).
Figure 24 Societal challenges in the field “Health, demographic change and wellbeing” important for the EU-Russia RDI cooperation

Russian questionnaire

- Promoting integrated care
- Improving scientific tools and methods to support...
- Specific implementation aspects (from knowledge and...
- Better use of health data
- Understanding disease
- Developing effective screening programmes and...
- Using in-silico medicine for improving disease...
- Improving surveillance and preparedness
- Optimising the efficiency and effectiveness of...
- Individual empowerment for self-management of health
- Developing better preventive vaccines
- Understanding the determinants of health, improving...
- Active ageing, independent and assisted living
- Transferring knowledge to clinical practice and...
- Treating disease
- Improving diagnosis

English questionnaire

- Specific implementation aspects (from knowledge and...
- Promoting integrated care
- Using in-silico medicine for improving disease...
- Individual empowerment for self-management of health
- Improving surveillance and preparedness
- Developing better preventive vaccines
- Optimising the efficiency and effectiveness of...
- Active ageing, independent and assisted living
- Improving scientific tools and methods to support...
- Better use of health data
- Developing effective screening programmes and...
- Transferring knowledge to clinical practice and...
- Treating disease
- Understanding the determinants of health, improving...
- Understanding disease
- Improving diagnosis
In the field “Health, demographic change and wellbeing” (considered by both Russian and EU experts as most important) most of experts underlined importance of improving diagnostics of diseases (82 experts or 14.75% — the Russian questionnaire; 67 experts or 12.27% — the English questionnaire).

For the other challenges the estimates made by Russian and European respondents were less even: the second most important issues were treating disease (70 experts or 12.59% — the Russian questionnaire) and understanding disease (66 experts or 12.09% — the English questionnaire); and the third ones: transferring knowledge to clinical practice and scalable innovation actions (69 experts or 12.41% — the Russian questionnaire) and understanding the determinants of health, improving health promotion and disease prevention (69 experts or 9.89% — the English questionnaire).

Figure 25 Societal challenges in the field “Food security, sustainable agriculture, marine and maritime research and the bio-economy” important for the EU-Russia RDI cooperation

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>English questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable agriculture and forestry</td>
<td>Sustainable agriculture and forestry</td>
</tr>
<tr>
<td>32.61%</td>
<td>29.79%</td>
</tr>
<tr>
<td>Sustainable and competitive agri-food sector for a safe and healthy diet</td>
<td>Specific implementation actions (e.g. specific support to SMEs, forward looking activities across the sectors of the bio-economy, etc.)</td>
</tr>
<tr>
<td>28.26%</td>
<td>23.40%</td>
</tr>
<tr>
<td>Unlocking the potential of aquatic living resources</td>
<td>Sustainable and competitive bio-based industries</td>
</tr>
<tr>
<td>8.70%</td>
<td>14.89%</td>
</tr>
<tr>
<td>Sustainable and competitive bio-based industries</td>
<td>Specific implementation actions (e.g. specific support to SMEs, forward looking activities across the sectors of the bio-economy, etc.)</td>
</tr>
<tr>
<td>15.22%</td>
<td>14.89%</td>
</tr>
</tbody>
</table>

The two most important for EU-Russia RDI cooperation societal challenges in the field “Food security, sustainable agriculture, marine and maritime research and the bio-economy” coincided for Russian and English questionnaires (figure 8):

1) Sustainable agriculture and forestry (32.61% — the Russian questionnaire) and specific implementation actions (29.79% — the English questionnaire).

2) Specific implementation actions (28.26% — the Russian questionnaire) and sustainable agriculture and forestry (23.40% — the English questionnaire).
Similar situation was observed for societal challenges in the field “Secure, clean and efficient energy” (figure 9), where the two most relevant social challenges for EU-Russia RDI cooperation identified by experts were:

- New knowledge and technologies (44.02% — the Russian questionnaire; 40.60% — the English questionnaire) and
- A single, smart electricity grid (13.59% — the Russian questionnaire; 12.03% — the English questionnaire).

The third position was given to alternative fuels and mobile energy sources by Russian experts (13.04%) and reducing energy consumption and carbon footprint through smart and sustainable usage by European experts (12.41%).
Figure 27 Societal challenges in the field “Smart, green and integrated transport” important for the EU-Russia RDI cooperation

Russian questionnaire

For the societal challenges in the field “Smart, green and integrated transport” Russian and EU experts agreed that the most important one was (figure 10) resource efficient transport that respects the environment (50% — the Russian questionnaire; 42.42% — the English questionnaire). Beyond that Russian experts paid most attention to better mobility, less congestion, more safety and security (25%) whereas the European experts underlined socio-economic research and forward looking activities for policy making (39.39%).
Figure 28 Societal challenges in the field “Climate action, resource efficiency and raw materials” important for the EU-Russia RDI cooperation

The most relevant social challenges for EU-Russia RDI cooperation in the field “Climate action, resource efficiency and raw materials” was (figure 11) developing comprehensive and sustained global environmental observation and information systems (48.35% — the Russian questionnaire; 27.56% — the English questionnaire). Beyond that, Russian and European experts marked specific implementation aspects (23.08% — the Russian and 12.6% — the English questionnaire) and sustainably managing natural resources and ecosystems (16.48% and 23.62% respectively).

Figure 29 Societal challenges in the field “Inclusive, innovative and secure societies” important for the EU-Russia RDI cooperation

As for the field “Inclusive, innovative and secure societies” (figure 12), an interesting result was that Russian experts did not mention inclusive societies as an important issue at all, whereas more than third of EU respondents mentioned it as important.

2.3 Thematic fields of cooperation

Question of the survey considered in this section:
Based upon your expertise, in which of the following fields the EU-Russia RDI cooperation will bring the most significant results by 2025?
Figure 30 Promising thematic fields of the EU-Russia RDI cooperation

Russian questionnaire

- 9.94% New materials and nanotechnologies
- 21.88% Medicine and health
- 28.43% Efficient environmental management
- 39.75% Social issues

English questionnaire

- 10.71% New materials and nanotechnologies
- 24.79% Medicine and health
- 25.33% Efficient environmental management
- 39.17% Social issues

Promising thematic fields of the EU-Russia RDI cooperation are presented in figure 13. The distribution of answers made by Russian and European respondents was surprisingly next to fully coincided. Around 40% of Russian and European experts agreed that the most perspective field of cooperation is “New materials and nanotechnologies”; “Medicine and health” was on the second place (more than 25% of respondents).

Further each thematic field of cooperation is considered in more details.

Figure 31 Promising thematic areas of the EU-Russia RDI cooperation in the field “New materials and nanotechnologies”

Russian questionnaire

- 22.16% Construction materials
- 11.55% Functional materials
- 10.80% Hybrid materials, convergent technologies, bio-mimetic materials, medical materials
- 47.35% Computer simulation of materials and processes
- 8.14% Diagnostics of materials

English questionnaire

- 15.47% Construction materials
- 51.14% Functional materials
- 16.17% Hybrid materials, convergent technologies, bio-mimetic materials, medical materials
- 7.73% Computer simulation of materials and processes
- 9.49% Diagnostics of materials

The distributions of replies by promising thematic fields of the EU-Russia RDI cooperation in the area “New materials and nanotechnologies” were again very close to each other in Russian and English questionnaires (figure 14).

For every area from the field “New materials and nanotechnologies” particular subareas were examined. The most perspective subareas of cooperation for each area are the following:

- In the area “Construction materials” — subarea “High strength materials” (for the Russian questionnaire); subarea “Light materials” (for the English questionnaire).
- In the area “Functional materials” — subarea “Materials for power generation and electrical engineering” (for the Russian questionnaire); subarea “Optical and lightning engineering materials” (for the English questionnaire).
- In the area “Hybrid materials, convergent technologies, bio-mimetic materials, medical materials” — subarea “Hybrid materials and convergent technologies” (for both questionnaires).

More detailed information is presented in the Annex.
The promising thematic fields of the EU-Russia RDI cooperation in the area “Social issues” were distributed less evenly in Russian and English parts of the survey (figure 15). For every area from the field “Social issues” particular subareas were examined. The most perspective subareas of cooperation for each area are the following:

- In the area “Modelling and forecasting global and national socio-economic and political trends, taking into account the development of S&T” — subarea “Demographic trends” (for both questionnaires).
- In the area “New mechanisms of economic activities” — subarea “Developing new sectors of the economy, including socio-economic and cultural aspects” (for the Russian questionnaire); subarea “A better integration of certain countries (e.g. Russia) into the international division of labour” (for the English questionnaire).
- In the area “Modelling and forecasting of S&T development” — subarea “Models of S&T development, emergence of breakthrough (“disruptive”) technologies with a high potential impact on the economy and society” (for the Russian questionnaire); subarea “Processes of global technology transfer and of know-how transfer” (for the English questionnaire).
- In the area “Development of human capital” — subarea “Development of staff training, of upgrading and lifelong learning systems in the context of global S&T trends” (for the Russian questionnaire); subarea “Potential demand for and supply of personnel and skills” (for the English questionnaire).
- In the area “Social stability, cohesion, social conflicts” — subarea “Models of social partnership, and development of civil society institutes” (for both questionnaires).
- In the area “Societal problems of innovation-based development” — subarea “Managing risks and challenges the society may face in the 21st century due to possible adverse effects of uncontrolled application of R&D results” (for the Russian questionnaire); subarea “Social/innovation lifts in a knowledge-based economy” (for the English questionnaire).

More detailed information is presented in the Annex.
The promising thematic fields of the EU-Russia RDI cooperation in the area “Efficient environmental management” were distributed very similarly for Russian and European respondents (figure 16).

For every area from the field “Efficient environmental management” particular subareas were examined. The most perspective subareas of cooperation for each area are the following:

- In the area “Environmental protection and safety technologies” — subarea “Assessment and forecasting of the integrated impact of natural and anthropogenic factors on people’s health and activities under changing climate and environment” (for the Russian questionnaire); subarea “Climate change, including regional and extreme climatic events; advanced approaches to analysing climate-forming factors” (for the English questionnaire).
- In the area “Technologies for monitoring the state of the environment, assessment and forecasting of natural and technogenic emergencies” — subarea “Technologies and systems for early detection and forecasting of natural and technogenic emergencies” (for the Russian questionnaire); subarea “Research on the industrial use of wastes from mining and raw materials processing” (for the English questionnaire).
- In the area “Technologies and systems for mineral prospecting and integrated development of mineral and hydrocarbon resources” — subarea “Research on the industrial use of wastes from mining and raw materials processing” (for both questionnaires).
- In the area “Inventory and utilisation of resources of the World Ocean, Arctic and Antarctic regions” — subarea “Research on environmentally safe marine prospecting and mining of various mineral resources under the extreme oceanic, Arctic and Antarctic environments” (for the English questionnaire).

More detailed information is presented in the Annex.
The assessments of promising thematic fields of the EU-Russia RDI cooperation in the area “Medicine and health” were again distributed very similarly for the Russian and English questionnaires (figure 17).

For each area from the field “Medicine and health” particular subareas were examined. The most perspective subareas of cooperation for each area are the following:

- In the area “Promising candidate drugs” — subarea “Screening (and increasing efficiency) of leads based on new pharmacological targets, and new research data on emergence and development mechanisms of disease” (for both questionnaires).
- In the area “Molecular diagnostics” — subarea “Integrated hardware/software solutions, analytical devices and reagents to analyse dynamic (adjustable) macromolecular markers, and laboratory protocols for their application” (for both questionnaires).
- In the area “Human proteome profiling” — subarea “Increasing sensitivity and productivity of clinical samples’ protein composition measurement techniques” (for the Russian questionnaire); subarea “Identification and quantification of transcripts, proteins, and their modifications (alternative splicing, post-translation modifications, single amino-acid polymorphisms) in human tissues” (for the English questionnaire).
- In the area “Biomedical cellular technology” — subarea “Development of biologically active substances for targeted regeneration of structure of human organs and tissues affected by disease” (for the Russian questionnaire); subarea “Tissue equivalents and in vitro production of artificial human organs”; “Preparations to stimulate regeneration, based on human cells cultivation products” (for the English questionnaire).
- In the area “Biodegradable and composite medical materials” — subarea “Materials stimulating regenerative processes in the body after transplantation, regulating cellular activity and differentiation” (for both questionnaires).
- In the area “Bio-electrodynamics and radiation medicine” — subarea “Ultra-high resolution internal structure visualisation system” (for both questionnaires).
- In the area “Creation of genome databases” — subarea “Genotype databases and knowledge bases of the Russian and the EU populations” (for the Russian questionnaire); subarea “Genotype databases and knowledge bases of the Russian and the EU populations” (for the English questionnaire).

More detailed information is presented in the Annex.
2.4 Framework conditions

Question of the survey considered in this section:
From the following list of cost categories please tick the two categories which should in particular be increased for improving EU-Russia RDI cooperation.
What needs to be done to intensify the exchanges (in terms of number and impact)?

Overall responses to English and Russian questionnaires

The most important cost categories which should in particular be increased for improving EU-Russia RDI cooperation are presented in figure 18. Most of experts underlined importance of salaries of researchers (415 of respondents: 215 Russian and 230 EU experts). For the second cost category the estimates made by Russian and European respondents were less even: the second most important cost category was research infrastructure (176 experts — the Russian questionnaire) and mobility (219 experts — the English questionnaire); and the third ones: mobility (158 experts — the Russian questionnaire) and research infrastructure (217 experts — the English questionnaire).
The most relevant issues for the mobility intensification are presented in figure 19. According to experts, visa procedures between the EU and Russia is the key issue for the mobility intensification (mentioned by 143 Russian respondents and 182 European respondents). Involvement of more mid career researchers in the exchanges between the EU and Russia was also highlighted by experts among the key issues (141 Russian respondents and 223 European respondents).

3 Annex

Table 1A Distribution of responses by subareas for the area “Construction materials” (field “New materials and nanotechnologies”)
### Table 2A Distribution of responses by subareas for the area “Functional materials”
(field “New materials and nanotechnologies”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>High strength materials</td>
<td>22</td>
</tr>
<tr>
<td>High thermal stability materials</td>
<td>19</td>
</tr>
<tr>
<td>Light materials</td>
<td>18</td>
</tr>
<tr>
<td>Construction-protecting materials</td>
<td>16</td>
</tr>
<tr>
<td>Smart and custom construction materials</td>
<td>15</td>
</tr>
<tr>
<td>Construction materials for power engineering</td>
<td>15</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>117</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light materials</td>
<td>18</td>
</tr>
<tr>
<td>Construction materials for power engineering</td>
<td>14</td>
</tr>
<tr>
<td>High strength materials</td>
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<tr>
<td>High thermal stability materials</td>
<td>12</td>
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<td>Smart and custom construction materials</td>
<td>12</td>
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<td>Construction-protecting materials</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>88</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials for power generation and electrical engineering</td>
<td>40</td>
</tr>
<tr>
<td>Functional coatings and layered materials</td>
<td>39</td>
</tr>
<tr>
<td>Optical and lightning engineering materials</td>
<td>38</td>
</tr>
<tr>
<td>Sensor materials</td>
<td>34</td>
</tr>
<tr>
<td>Magnetic materials</td>
<td>34</td>
</tr>
<tr>
<td>Nano-size catalysts for deep processing of raw materials</td>
<td>26</td>
</tr>
<tr>
<td>Hybrid and nanostructured membrane materials</td>
<td>25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>250</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optical and lightning engineering materials</td>
<td>46</td>
</tr>
<tr>
<td>Materials for power generation and electrical engineering</td>
<td>43</td>
</tr>
<tr>
<td>Sensor materials</td>
<td>40</td>
</tr>
<tr>
<td>Magnetic materials</td>
<td>34</td>
</tr>
<tr>
<td>Functional coatings and layered materials</td>
<td>33</td>
</tr>
<tr>
<td>Hybrid and nanostructured membrane materials</td>
<td>31</td>
</tr>
<tr>
<td>Nano-size catalysts for deep processing of raw materials</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>251</strong></td>
</tr>
</tbody>
</table>

### Table 3A Distribution of responses by subareas for the area “Hybrid materials, convergent technologies, bio-mimetic materials, medical materials”
(field “New materials and nanotechnologies”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-mimetic and medical materials</td>
<td>25</td>
</tr>
<tr>
<td>Hybrid materials and convergent technologies</td>
<td>19</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid materials and convergent technologies</td>
<td>38</td>
</tr>
<tr>
<td>Bio-mimetic and medical materials</td>
<td>24</td>
</tr>
<tr>
<td>Russian questionnaire</td>
<td>Number of experts</td>
</tr>
<tr>
<td>-----------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Screening (and increasing efficiency) of leads based on new pharmacological targets, and new research data on emergence and development mechanisms of disease</td>
<td>17</td>
</tr>
<tr>
<td>New leads, including multi-purpose ones, using both known and newly discovered targets via genetic engineering, biotechnology, in silico modelling and medical chemistry techniques</td>
<td>16</td>
</tr>
<tr>
<td>Components and systems for targeted drug delivery, to increase efficiency, improve pharmacokinetic properties, and reduce toxicity of leads, and lab protocols for their development</td>
<td>16</td>
</tr>
<tr>
<td>New vaccines, including combined ones.</td>
<td>12</td>
</tr>
<tr>
<td>Models based on cell lines and/or laboratory animals, for preclinical research of human diseases</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>72</strong></td>
</tr>
</tbody>
</table>

**Table 5A Distribution of responses by subareas for the area “Molecular diagnostics” (field “Medicine and health”)**

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integrated hardware/software solutions, analytical devices and reagents to analyse dynamic (adjustable) macromolecular markers, and laboratory protocols for their application</td>
<td>18</td>
<td>Integrated hardware/software solutions based on static (context-based) macromolecular markers’ analysis, to develop optimal healing strategies, assess</td>
<td>20</td>
</tr>
</tbody>
</table>
Infectious agents’ detection techniques, and laboratory protocols for their application | 17
---|---
Integrated hardware/software solutions based on static (context-based) macromolecular markers’ analysis, to develop optimal healing strategies, assess individual predisposition to diseases, and prepare their development forecasts | 13
Integrated hardware/software solutions, analytical devices and reagents to analyse dynamic (adjustable) macromolecular markers, and laboratory protocols for their application | 18
Integrated hardware/software solutions, analytical devices and reagents to analyse low-molecular compounds, and laboratory protocols for their application | 13

**Total** | **58**

**Infectious agents’ detection techniques, and laboratory protocols for their application** | **19**

Integrated hardware/software solutions, analytical devices and reagents to analyse dynamic (adjustable) macromolecular markers, and laboratory protocols for their application | 18
Integrated hardware/software solutions, analytical devices and reagents to analyse low-molecular compounds, and laboratory protocols for their application | 13

**Total** | **70**

---

**Table 6A Distribution of responses by subareas for the area “Human proteome profiling” (field “Medicine and health”)**

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increasing sensitivity and productivity of clinical samples’ protein composition measurement techniques</td>
<td>5</td>
</tr>
<tr>
<td>Identification and quantification of transcripts, proteins, and their modifications (alternative splicing, post-translation modifications, single amino-acid polymorphisms) in human tissues</td>
<td>4</td>
</tr>
<tr>
<td>Obtaining, for each gene’s products, experimental data on their presence in the bodies of patients with the diagnosed disease</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification and quantification of transcripts, proteins, and their modifications (alternative splicing, post-translation modifications, single amino-acid polymorphisms) in human tissues</td>
<td>6</td>
</tr>
<tr>
<td>Increasing sensitivity and productivity of clinical samples’ protein composition measurement techniques</td>
<td>4</td>
</tr>
<tr>
<td>Obtaining, for each gene’s products, experimental data on their presence in the bodies of patients with the diagnosed disease</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>
### Table 7A Distribution of responses by subareas for the area “Biomedical cellular technology” (field “Medicine and health”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of biologically active substances for targeted regeneration of structure of human organs and tissues affected by disease</td>
<td>15</td>
<td>Tissue equivalents and in vitro production of artificial human organs</td>
<td>12</td>
</tr>
<tr>
<td>Human tissues’ and organs’ regeneration techniques based on self-cells and donor cells, and tissue equivalents stimulating regeneration of preparations and cell cultivation products</td>
<td>13</td>
<td>Preparations to stimulate regeneration, based on human cells cultivation products</td>
<td>12</td>
</tr>
<tr>
<td>Medicines to stimulate regeneration, based on human cells cultivation products</td>
<td>13</td>
<td>Human cells cultivation, modification and reprogramming techniques</td>
<td>11</td>
</tr>
<tr>
<td>Systems for efficient cultivation of human cells, adjusting their properties, and targeted differentiation for tissue engineering and cell therapy purposes</td>
<td>12</td>
<td>Human tissues’ and organs’ regeneration techniques based on self-cells and donor cells, and tissue equivalents stimulating regeneration of preparations and cell cultivation products</td>
<td>10</td>
</tr>
<tr>
<td>Human cells cultivation, modification and reprogramming techniques</td>
<td>11</td>
<td>Systems for efficient cultivation of human cells, adjusting their properties, and targeted differentiation for tissue engineering and cell therapy purposes</td>
<td>8</td>
</tr>
<tr>
<td>Tissue equivalents and in vitro production of artificial human organs</td>
<td>10</td>
<td>Development of biologically active substances for targeted regeneration of structure of human organs and tissues affected by disease</td>
<td>7</td>
</tr>
<tr>
<td>Assessment of bio-safety of biomedical medicines and cellular products</td>
<td>7</td>
<td>Assessment of bio-safety of biomedical preparations and cellular products</td>
<td>7</td>
</tr>
<tr>
<td>Techniques for safe conservation and storage of cellular products</td>
<td>5</td>
<td>Techniques for safe conservation and storage of cellular products</td>
<td>6</td>
</tr>
<tr>
<td><strong>Sum</strong></td>
<td><strong>86</strong></td>
<td><strong>Total</strong></td>
<td><strong>73</strong></td>
</tr>
</tbody>
</table>
Table 8A **Distribution of responses by subareas for the area “Biodegradable and composite medical materials” (field “Medicine and health”)**

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials stimulating regenerative processes in the body after transplantation, regulating cellular activity and differentiation</td>
<td>10</td>
<td>Materials stimulating regenerative processes in the body after transplantation, regulating cellular activity and differentiation</td>
<td>9</td>
</tr>
<tr>
<td>Functional-structure composite materials for dental and maxillofacial implants</td>
<td>8</td>
<td>Biomechanically compatible cardiologic and intestinal implants and stents with functional coatings</td>
<td>7</td>
</tr>
<tr>
<td>Biomechanically compatible cardiologic and intestinal implants and stents with functional coatings</td>
<td>7</td>
<td>Orthopaedics materials imitating bone tissue architectonics</td>
<td>5</td>
</tr>
<tr>
<td>Orthopaedics materials imitating bone tissue architectonics</td>
<td>6</td>
<td>Functional-structure composite materials for dental and maxillofacial implants</td>
<td>4</td>
</tr>
<tr>
<td>Special-purpose materials for external use</td>
<td>2</td>
<td>Special-purpose materials for external use</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>33</strong></td>
<td><strong>Total</strong></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>

Table 9A **Distribution of responses by subareas for the area “Bio-electrodynamics and radiation medicine” (field “Medicine and health”)**

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact devices for interaction between cells and artificial systems, to substitute damaged organs’ functions</td>
<td>5</td>
<td>Ultra-high resolution internal structure visualisation system</td>
<td>9</td>
</tr>
<tr>
<td>Integrated electronic control devices to restore damaged functionality and monitor the body’s current state, including remotely</td>
<td>5</td>
<td>Development of high-sensitivity sensors for human body’s physical and physiological parameters</td>
<td>8</td>
</tr>
<tr>
<td>Ultra-high resolution internal structure visualisation system</td>
<td>9</td>
<td>Development of chemical compounds, including photosensitizers and compound-contrasts, to interact with applied external factors for diagnostic and therapeutic purposes</td>
<td>8</td>
</tr>
<tr>
<td>Development of high-sensitivity sensors for human body’s physical and physiological parameters</td>
<td>7</td>
<td>Contact devices for interaction between cells and artificial systems, to substitute damaged organs’ functions</td>
<td>7</td>
</tr>
</tbody>
</table>
Development of chemical compounds, including photosensitizers and compound-contrasts, to interact with applied external factors for diagnostic and therapeutic purposes  

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genotype databases and knowledge bases of the Russian and the EU populations</td>
<td>8</td>
</tr>
<tr>
<td>Databases and knowledge bases of genes and gene networks affecting pharmacotherapy efficiency</td>
<td>8</td>
</tr>
<tr>
<td>Databases and knowledge bases of clinical-associated single- and multiple-nucleotide polymorphisms</td>
<td>7</td>
</tr>
<tr>
<td>Databases and knowledge bases of clinically-significant human transcriptional and epigenetic profiles</td>
<td>7</td>
</tr>
<tr>
<td>Prototypes of integrated hardware/software solutions and lab protocols for applying reagents for whole genome DNA sequencing</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
</tr>
</tbody>
</table>

Integrated electronic control devices to restore damaged functionality and monitor the body’s current state, including remotely  

<table>
<thead>
<tr>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Genotype databases and knowledge bases of the Russian and the EU populations</td>
<td>13</td>
</tr>
<tr>
<td>Databases and knowledge bases of genes and gene networks affecting pharmacotherapy efficiency</td>
<td>9</td>
</tr>
<tr>
<td>Prototypes of integrated hardware/software solutions and lab protocols for applying reagents for full-genome DNA sequencing</td>
<td>8</td>
</tr>
<tr>
<td>Databases and knowledge bases of clinically-significant human transcriptional and epigenetic profiles</td>
<td>8</td>
</tr>
<tr>
<td>Databases and knowledge bases of clinical-associated single- and multiple-nucleotide polymorphisms</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>45</td>
</tr>
</tbody>
</table>

### Table 10A Distribution of responses by subareas for the area “Creation of genome databases” (field “Medicine and health”)  

### Table 11A Distribution of responses by subareas for the area “Environmental protection and safety technologies” (field “Efficient environmental management”)  

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment and forecasting of the integrated impact of natural and anthropogenic factors on people’s health and activities under changing climate and environment</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change, including regional and extreme climatic events; advanced approaches to analysing climate-forming factors</td>
<td>18</td>
</tr>
<tr>
<td>Topic</td>
<td>Number of Projects</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Assessment of changes in the environmental state of landscapes and their components, including land forms, erosion and channel processes, water bodies and their ecosystems, soils, biogeochemical flows, bioproductivity and biodiversity</td>
<td>13</td>
</tr>
<tr>
<td>Development of forecasts for transfer and transformation of environmental pollutants, including micro- and nanoparticles</td>
<td>12</td>
</tr>
<tr>
<td>Climate change, including regional and extreme climatic events; advanced approaches to analysing climate-forming factors</td>
<td>11</td>
</tr>
<tr>
<td>Dynamics of atmospheric circulation systems, including basic climate modes, non-tropical and tropical cyclones, and their role in emergence of atmospheric circulation anomalies</td>
<td>10</td>
</tr>
<tr>
<td>Optimisation of territorial planning schemes in accordance with the landscape structure, environmental and natural resource potential</td>
<td>8</td>
</tr>
<tr>
<td>Reconstruction of the past and assessment of the modern cryosphere dynamics, including permafrost ground and glaciers, and forecast of their possible changes</td>
<td>6</td>
</tr>
<tr>
<td>Efficient environment management systems for cities and urban agglomerations, spatial patterns of economy and population</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>78</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topic</th>
<th>Number of Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assessment of changes in the environmental state of landscapes and their components, including land forms, erosion and channel processes, water bodies and their ecosystems, soils, biogeochemical flows, bioproductivity and biodiversity</td>
<td>14</td>
</tr>
<tr>
<td>Development of forecasts for transfer and transformation of environmental pollutants, including micro- and nanoparticles</td>
<td>13</td>
</tr>
<tr>
<td>Development of forecasts for transfer and transformation of environmental pollutants, including micro- and nanoparticles</td>
<td>14</td>
</tr>
<tr>
<td>Reconstruction of the past and assessment of the modern cryosphere dynamics, including permafrost ground and glaciers, and forecast of their possible changes</td>
<td>13</td>
</tr>
<tr>
<td>Efficient environment management systems for cities and urban agglomerations, spatial patterns of economy and population</td>
<td>10</td>
</tr>
<tr>
<td>Optimisation of territorial planning schemes in accordance with the landscape structure, environmental and natural resource potential</td>
<td>10</td>
</tr>
<tr>
<td>Dynamics of atmospheric circulation systems, including basic climate modes, non-tropical and tropical cyclones, and their role in emergence of atmospheric circulation anomalies</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>96</strong></td>
</tr>
</tbody>
</table>
Table 12A Distribution of responses by subareas for the area “Technologies for monitoring the state of the environment, assessment and forecasting of natural and technogenic emergencies” (field “Efficient environmental management”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technologies for instrument-based monitoring of pollutant emissions/dumping into the atmosphere, water bodies and soils</td>
<td>15</td>
<td>Assessment of the current state and dynamics of water and land ecosystems’ resources, and recovery of resource potential of the areas experiencing high anthropogenic pressure (soils, biological and water resources)</td>
<td>18</td>
</tr>
<tr>
<td>Technologies and systems for early detection and forecasting of natural and technogenic emergencies</td>
<td>13</td>
<td>Monitoring and forecasting the state of the environment in large industrial cities, protected nature areas, coastal zones, water bodies, and underground water reservoirs</td>
<td>16</td>
</tr>
<tr>
<td>Assessment of the current state and dynamics of water and land ecosystems’ resources, and recovery of resource potential of the areas experiencing high anthropogenic pressure (soils, biological and water resources)</td>
<td>12</td>
<td>Technologies and systems for monitoring environmental effects of climate change, including processes in permafrost areas</td>
<td>15</td>
</tr>
<tr>
<td>Technologies for obtaining, transfer and application of information about the state of the environment and its dynamics, using land-, air-, space-based and other systems</td>
<td>12</td>
<td>Technologies for instrument-based monitoring of pollutant emissions/dumping into the atmosphere, water bodies and soils</td>
<td>14</td>
</tr>
<tr>
<td>Technologies for increasing safety of potentially hazardous industrial and power-generating facilities, including chemical plants, oil refineries, mines, high-head dams, hydropower and nuclear power plants</td>
<td>9</td>
<td>Technologies for increasing safety of potentially hazardous industrial and power-generating facilities, including chemical plants, oil refineries, mines, high-head dams, hydropower and nuclear power plants</td>
<td>14</td>
</tr>
<tr>
<td>Technologies for managing environmental risks at offshore oil and gas wells, including those in the ice-covered areas</td>
<td>7</td>
<td>Technologies and systems for early detection and forecasting of natural and technogenic emergencies</td>
<td>12</td>
</tr>
<tr>
<td>Technologies and systems for monitoring environmental effects of climate change, including processes in permafrost areas</td>
<td>7</td>
<td>Technologies for managing environmental risks at offshore oil and gas wells, including those in the ice-</td>
<td>11</td>
</tr>
<tr>
<td>Area</td>
<td>Russian questionnaire</td>
<td>Number of experts</td>
<td>English questionnaire</td>
</tr>
<tr>
<td>---------------------------------------------------------------------</td>
<td>-----------------------</td>
<td>-------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Technologies for developing and updating registries of land and water areas with the highest environmental risks</td>
<td>5</td>
<td></td>
<td>Technologies for obtaining, transfer and application of information about the state of the environment and its dynamics, using land-, air-, space-based and other systems</td>
</tr>
<tr>
<td>Technologies and systems for preventing adverse transboundary environmental impact</td>
<td>5</td>
<td></td>
<td>Technologies for developing and updating registries of land and water areas with the highest environmental risks</td>
</tr>
<tr>
<td>Monitoring and forecasting the state of the environment in large industrial cities, protected nature areas, coastal zones, water bodies, and underground water reservoirs</td>
<td>0</td>
<td></td>
<td>Technologies and systems for preventing adverse transboundary environmental impact</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td></td>
<td>Total</td>
</tr>
</tbody>
</table>

Table 13A Distribution of responses by subareas for the area “Technologies and systems for mineral prospecting and integrated development of mineral and hydrocarbon resources” (field “Efficient environmental management”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research on the industrial use of wastes from mining and raw materials processing</td>
<td>9</td>
<td>Research on the industrial use of wastes from mining and raw materials processing</td>
<td>16</td>
</tr>
<tr>
<td>Research on the utilisation of associated petroleum gas</td>
<td>8</td>
<td>Prospecting-related research, including new mining areas meeting economic-related and environment protection requirements; development of geophysical techniques for oil and gas prospecting under unconventional geological conditions; assessment of oilfields’ production potentials; techniques and technologies for detecting potential ore targets</td>
<td>8</td>
</tr>
</tbody>
</table>
Prospecting-related research, including new mining areas meeting economic-related and environment protection requirements; development of geophysical techniques for oil and gas prospecting under unconventional geological conditions; assessment of oilfields’ production potentials; techniques and technologies for detecting potential ore targets

Identification and utilisation of non-conventional raw material sources, including hydrocarbons, such as heavy crudes, gas-hydrates, shale gas etc.

Development of physics- and chemistry-based technologies for processing highly gaseous coal layers to prevent possible emissions of coalmine methane, including for the production of gaseous and liquid synthetic hydrocarbons

Techniques to enhance oil recovery, including targeted adjustment of reservoir collecting properties to increase hydrocarbons’ recovery rates, including for the depleted sites and low-pressure gas fields

Technologies for efficient processing of solid minerals, including energy-saving processing of hard-to-enrich natural and anthropogenic mineral raw materials with high concentrations of mineral complexes

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prospecting-related research, including new mining areas meeting economic-related and environment protection requirements; development of geophysical techniques for oil and gas prospecting under unconventional geological conditions; assessment of oilfields’ production potentials; techniques and technologies for detecting potential ore targets</td>
</tr>
<tr>
<td></td>
<td>Identification and utilisation of non-conventional raw material sources, including hydrocarbons, such as heavy crudes, gas-hydrates, shale gas etc.</td>
</tr>
<tr>
<td></td>
<td>Development of physics- and chemistry-based technologies for processing highly gaseous coal layers to prevent possible emissions of coalmine methane, including for the production of gaseous and liquid synthetic hydrocarbons</td>
</tr>
<tr>
<td></td>
<td>Techniques to enhance oil recovery, including targeted adjustment of reservoir collecting properties to increase hydrocarbons’ recovery rates, including for the depleted sites and low-pressure gas fields</td>
</tr>
<tr>
<td></td>
<td>Technologies for efficient processing of solid minerals, including energy-saving processing of hard-to-enrich natural and anthropogenic mineral raw materials with high concentrations of mineral complexes</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>46</td>
</tr>
</tbody>
</table>
Table 14A Distribution of responses by subareas for the area “Inventory and utilisation of resources of the World Ocean, Arctic and Antarctic regions” (field “Efficient environmental management”)

<table>
<thead>
<tr>
<th>Subarea</th>
<th>Number of experts</th>
<th>Russian questionnaire</th>
<th>English questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth remote sensing technologies, including those of environmental</td>
<td>12</td>
<td>Research on environment safe marine prospecting and mining of various mineral resources</td>
<td>Research on innovative technologies for ensuring overall safety of activities within</td>
</tr>
<tr>
<td>monitoring, resource evaluation and forecasting of the state of the</td>
<td></td>
<td></td>
<td>the Arctic Federation’s continental shelf, in the Arctic and Antarctic, including</td>
</tr>
<tr>
<td>environment in the Russian Federation’s Arctic areas, using the</td>
<td></td>
<td></td>
<td>technologies for monitoring and forecasting natural and anthropogenic emergencies</td>
</tr>
<tr>
<td>Russian Arctica multipurpose space system; development of automated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>information collection and processing systems for the remote Arctic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>and Antarctic areas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research on environment safe marine prospecting and mining of various</td>
<td>8</td>
<td>Research on environmentally safe marine prospecting and mining of various mineral</td>
<td>Research on prevention and managing accidental oil spills, primarily in the ice-bound</td>
</tr>
<tr>
<td>mineral resources under the extreme oceanic, Arctic and Antarctic</td>
<td></td>
<td>resources under the extreme oceanic, Arctic and Antarctic environments</td>
<td>areas, including development of technologies for under-ice oil identification</td>
</tr>
<tr>
<td>environments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research on prevention and managing accidental oil spills, primarily</td>
<td>7</td>
<td>Earth remote sensing technologies, including those of environmental monitoring,</td>
<td>地球深海探索技术，包括环境监测、资源评估和预测技术在俄罗斯联邦的北极区域的深海水域；发展自动化信息收集和处理系统用于远程北极和南极区域。</td>
</tr>
<tr>
<td>in the ice-bound areas, including development of technologies for</td>
<td></td>
<td>resource evaluation and forecasting of the state of the environment in the Russian</td>
<td></td>
</tr>
<tr>
<td>under-ice oil identification</td>
<td></td>
<td>Federation’s Arctic areas, using the Russian Arctica multipurpose space system;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>development of automated information collection and processing systems for the remote</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Arctic and Antarctic areas</td>
<td></td>
</tr>
</tbody>
</table>
Technologies for integrated hydro-meteorological and environmental monitoring of dangerous natural phenomena, first of all ice situation in the Arctic and Antarctic, as well as in other areas of the World ocean | 6
---|---
Research on innovative technologies for ensuring overall safety of activities within the Russian Federation’s continental shelf, in the Arctic and Antarctic, including technologies for monitoring and forecasting natural and anthropogenic emergencies | 4

**Total** | **43**

Technologies for integrated hydro-meteorological and environmental monitoring of dangerous natural phenomena, first of all ice situation in the Arctic and Antarctic, as well as in other areas of the World ocean | 8

Research on innovative technologies for ensuring overall safety of activities within the Russian Federation’s continental shelf, in the Arctic and Antarctic, including technologies for monitoring and forecasting natural and anthropogenic emergencies | 6

**Total** | **53**

### Table 15A Distribution of responses by subareas for the area “Modelling and forecasting global and national socio-economic and political trends, taking into account the development of S&T” (field “Social issues”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic trends</td>
<td>3</td>
<td>Demographic trends</td>
<td>6</td>
</tr>
<tr>
<td>Models of a new world order</td>
<td>2</td>
<td>Global resource markets, and analysis of their trends</td>
<td>6</td>
</tr>
<tr>
<td>Interaction processes in the economy, in S&amp;T, in humanities and in other spheres in the region of the former Soviet Union</td>
<td>2</td>
<td>Interaction processes in the economy, in S&amp;T, in humanities and in other spheres in the region of the former Soviet Union</td>
<td>6</td>
</tr>
<tr>
<td>Forecasting models of socio-economic trends, and current state of societal development</td>
<td>2</td>
<td>Forecasting models of socio-economic trends, and current state of societal development</td>
<td>6</td>
</tr>
<tr>
<td>Global resource markets, and analysis of their trends</td>
<td>0</td>
<td>Evolution of management systems, and emergence of management elites</td>
<td>4</td>
</tr>
<tr>
<td>Evolution of management systems, and emergence of management elites</td>
<td>0</td>
<td>Models of a new world order</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

### Table 16A Distribution of responses by subareas for the area “New mechanisms of economic activities” (field “Social issues”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models of a new world order</td>
<td>0</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Evolution of management systems, and emergence of management elites</td>
<td>0</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
</tr>
<tr>
<td>Developing new sectors of the economy, including socio-economic and cultural aspects</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transformation of global value chains</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institutional analysis and implementation of reforms</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A better integration of certain countries (e.g. Russia) into the international division of labour</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global financial markets</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| A better integration of certain countries (e.g. Russia) into the international division of labour | 6 |
| Developing new sectors of the economy, including socio-economic and cultural aspects | 4 |
| Transformation of global value chains          | 3 |
| Global financial markets                       | 2 |
| Institutional analysis and implementation of reforms | 1 |
| **Total**                                     | **16** |

**Table 17A** Distribution of responses by subareas for the area “Modelling and forecasting of S&T development” (field “Social issues”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models of S&amp;T development, emergence of breakthrough (“disruptive”) technologies with a high potential impact on the economy and society</td>
<td>9</td>
</tr>
<tr>
<td>Models for the organisation of the R&amp;D sector and of innovation systems</td>
<td>5</td>
</tr>
<tr>
<td>Processes of global technology transfer and of know-how transfer</td>
<td>3</td>
</tr>
<tr>
<td>Evidence-based innovation policy</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processes of global technology transfer and of know-how transfer</td>
<td>7</td>
</tr>
<tr>
<td>Models of S&amp;T development, emergence of breakthrough (“disruptive”) technologies with a high potential impact on the economy and society</td>
<td>4</td>
</tr>
<tr>
<td>Models for the organisation of the R&amp;D sector and of innovation systems</td>
<td>3</td>
</tr>
<tr>
<td>Evidence-based innovation policy</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
</tr>
</tbody>
</table>
## Table 18A Distribution of responses by subareas for the area “Development of human capital” (field “Social issues”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of staff training, of upgrading and lifelong learning systems in the context of global S&amp;T trends</td>
<td>15</td>
<td>Potential demand for and supply of personnel and skills</td>
<td>11</td>
</tr>
<tr>
<td>Global migration flows, and their forecasts until 2050</td>
<td>5</td>
<td>Development of staff training, of upgrading and lifelong learning systems in the context of global S&amp;T trends</td>
<td>9</td>
</tr>
<tr>
<td>Potential demand for and supply of personnel and skills</td>
<td>4</td>
<td>Global migration flows, and their forecasts until 2050</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24</strong></td>
<td><strong>Total</strong></td>
<td><strong>28</strong></td>
</tr>
</tbody>
</table>

## Table 19A Distribution of responses by subareas for the area “Social stability, cohesion, social conflicts” (field “Social issues”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models of social partnership, and development of civil society institutes</td>
<td>7</td>
<td>Models of social partnership, and development of civil society institutes</td>
<td>10</td>
</tr>
<tr>
<td>Models of group relations, diagnostics of group conflicts</td>
<td>6</td>
<td>Models of group relations, diagnostics of group conflicts</td>
<td>9</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>13</strong></td>
<td><strong>Total</strong></td>
<td><strong>19</strong></td>
</tr>
</tbody>
</table>

## Table 20A Distribution of responses by subareas for the area “Regional policy and sustainable development of regions and urban agglomerations” (field “Social issues”)

<table>
<thead>
<tr>
<th>Russian questionnaire</th>
<th>Number of experts</th>
<th>English questionnaire</th>
<th>Number of experts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable development models for regions and cities, taking into account infrastructural and institutional limitations</td>
<td>7</td>
<td>Sustainable development models for regions and cities, taking into account infrastructural and institutional limitations</td>
<td>8</td>
</tr>
<tr>
<td>Russian questionnaire</td>
<td>Number of experts</td>
<td>English questionnaire</td>
<td>Number of experts</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------</td>
<td>-------------------</td>
<td>-----------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Managing risks and challenges the society may face in the 21st century due to possible adverse effects of uncontrolled application of R&amp;D results</td>
<td>8</td>
<td>Social/innovation lifts in a knowledge-based economy</td>
<td>6</td>
</tr>
<tr>
<td>Models of modern innovative societies, changes in behaviour patterns and values</td>
<td>7</td>
<td>Models of modern innovative societies, changes in behaviour patterns and values</td>
<td>5</td>
</tr>
<tr>
<td>Social/innovation lifts in a knowledge-based economy</td>
<td>5</td>
<td>Integrating various social groups into innovation processes, efficient mechanisms for promoting the emergence of a creative class and mass emergence of small innovative businesses</td>
<td>4</td>
</tr>
<tr>
<td>Integrating various social groups into innovation processes, efficient mechanisms for promoting the emergence of a creative class and mass emergence of small innovative businesses</td>
<td>5</td>
<td>Managing risks and challenges the society may face in the 21st century due to possible adverse effects of uncontrolled application of R&amp;D results</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>Total</td>
<td>18</td>
</tr>
</tbody>
</table>
8.4 Annex 4: Meta-analysis paper – thematic foresight

Questionnaire expert assessment – thematic foresight

Input for Deliverable D4.1 on the ERA.Net RUS foresight exercise aiming at identifying relevant and promising thematic fields for S&T and innovation cooperation between EU MS/AC and Russia

Input for D4.1:
Thematic S&T priorities for the European Union and the Russian Federation

Meta-analysis of thematic priorities in 2020

<table>
<thead>
<tr>
<th>Commissioned by:</th>
<th>EUROPEAN COMMISSION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DIRECTORATE-GENERAL JRC</td>
</tr>
<tr>
<td></td>
<td>JOINT RESEARCH CENTRE Institute for Prospective</td>
</tr>
<tr>
<td></td>
<td>Technological Studies (Seville)</td>
</tr>
<tr>
<td></td>
<td><strong>Knowledge for Growth Unit</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Client:</th>
<th>ERA.Net RUS Coordinator DLR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project:</td>
<td>ERA.Net RUS – Linking Russia to the ERA</td>
</tr>
<tr>
<td></td>
<td>Grant agreement no. FP7-226164</td>
</tr>
<tr>
<td>Input for Deliverable D4.1:</td>
<td>Meta analysis of thematic S&amp;T priorities for EU-RF</td>
</tr>
<tr>
<td>Version:</td>
<td>First version</td>
</tr>
<tr>
<td>Submission Date:</td>
<td>31 August, 2011</td>
</tr>
<tr>
<td>Authors:</td>
<td>Vicente Carabias, JRC-IPTS</td>
</tr>
<tr>
<td></td>
<td>Karel Haegeman, JRC-IPTS</td>
</tr>
<tr>
<td></td>
<td>Alexander Sokolov, HSE</td>
</tr>
<tr>
<td></td>
<td>Manfred Spiesberger, ZSI</td>
</tr>
</tbody>
</table>
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1. Introduction

The EU has for the past 15 years had a very rich scientific and technological relationship with Russia. In the framework of the ERA.Net RUS project (http://www.eranet-rus.eu/), a targeted foresight exercise is aiming at identifying and elaborating future core arenas of S&T and innovation cooperation between the EU and Russia. Scenarios are going to be developed to explore sustainable mid-term cooperation in S&T and innovation between the EU MS/AC and Russia.

In a Joint ERA.Net RUS Creativity and IPTS Foresight Workshop on 16-17 December 2010 the critical variables were discussed and the dimensions of these scenarios defined. The proposed scenarios will be further refined and fully elaborated through story telling by ERA.Net RUS partners. The resulting scenarios shall then be validated by the Joint S&T Committee Meeting between EU and RF and by the group of ERA.Net RUS funding partners during 2011.

As preparation of the forthcoming scenarios development, stock taking and analysis of existing information on EU-Russia relations with an explicit focus on their implications for science and technology is required besides acknowledging the findings of WP1 (analytical work on EU-Russia S&T cooperation patterns), the relevant literature and the results of other relevant strategic projects (incl. a S&T Delphi study from HSE).

This document shall contribute to the identification of thematic fields relevant and most promising for S&T cooperation between EU MS/AC and Russia. For this purpose, promising fields that overlap in foresight studies in Russia and EU, France, Germany, UK shall be highlighted.

In this meta-analysis we single out future thematic S&T priorities (in 2020) for the European Union and the Russian Federation.

2. Future thematic S&T priorities for the European Union

The purpose of the internet and literature review is to build on existing information – in order to gain policy ownership in EU – and finally to come up with a list of thematic priorities, relevant for future S&T within the EU and key EU MS/AC (such as France, Germany and UK). In view of their potential for EU – RF RTD cooperation in 2020, this list shall then be cross-checked with the respective list of thematic priorities based on Russian Foresight (incl. 25 future critical technology clusters) and validated by researchers and business engaged in EU – RF RTD cooperation.

Priority-setting in RTD-policy has become an issue of major concern in most OECD countries, and in particular in the EU where the emergence of the European Research Area has triggered a debate on the (re-)focusing of national research and technology portfolios (Gassler et al., 2004). Prioritisation on the public S&T side is necessary for two main reasons. Firstly, prioritisation needs to be done on public side because of budgetary limitation. Without prioritisation there is a (likely) danger that the limited public budget will be scattered and fragmented along too many unrelated research and innovation projects. Second, another reason for prioritisation is to express the societal relevance of certain research questions: a large part of S&T activities

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7 Brummer et al. (2009) accentuated that the development of thematic R&D priorities is widely regarded as one of the key objectives of participatory foresight activities and that by fostering future-orientation, broad stakeholder participation, multiple perspectives and mutual learning, foresight may mitigate the risks of establishing priorities based on considerations that are either too narrow in scope or too present-oriented in terms of planning horizons. Moreover, foresight may also contribute to the structural re-shaping of the innovation system, for example by building new collaborative networks or creating new patterns of knowledge diffusion among the stakeholders.

8 For more information on priority setting in S&T policy consult the "Guidelines and description of methodology for S&T priority setting" developed in the context of the WBC-INCO.Net in 2008 by UNU-MERIT.
are considered as valuable activities through their contribution to larger societal development goals, and hence the most relevant activities should be given higher priority. It is about matching S&T to future needs.

There is a danger that prioritisation exercises remain disconnected from actual policy making: the prioritisation exercise is of value if it is clearly linked to policies, and results in decisions concerning the distribution of public research funds.

The current performance of European research and innovation systems – at EU and Member State levels – warrants policy interventions designed to improve their performance. Policy responses are needed at EU level to support Member States in their attempts to improve the performance of their own research and innovation systems; to improve the performance of the EU system as a whole; and to ensure that the EU plays a leading role in the global economy.

Research and innovation are inter-related but independent concepts\(^9\). Research involves the investment of resources in attempts to expand our scientific and technological knowledge base, often in order to solve particular problems that confront different sectors of society, but also to satisfy the demands of intellectual curiosity. Innovation, on the other hand, involves the creation of value via the introduction of new products, processes, services and ways of doing things. Innovation requires knowledge inputs drawn not only from the arena of scientific and technological research, but also from many other sources. This broad concept of innovation can thus include the introduction of new products, processes and services ("product, process and service innovation"); innovations that involve changes in the way business or manufacturing processes are organized ("organisational innovation"); innovation that draws heavily upon knowledge inputs from customers and markets ("user-driven innovation"); changes in the way that firms and other organisations access and exploit knowledge to produce innovations ("open innovation"); and innovations in the way that society organises itself, especially the different ways that the public sector serves the needs of society at large ("social innovation").

2.1. Europe 2020 strategy

Europe 2020 is the EU's growth strategy\(^10\) for the coming decade. In a changing world, the Commission wants the EU to become a smart, sustainable and inclusive economy. These three mutually reinforcing priorities should help the EU and the Member States deliver high levels of employment, productivity and social cohesion:

- **Smart growth**: developing an economy based on knowledge and innovation.
- **Sustainable growth**: promoting a more resource efficient, greener and more competitive economy.
- **Inclusive growth**: fostering a high-employment economy delivering social and territorial cohesion.

The Commission is proposing five measurable EU targets for 2020 that will steer the process and be translated into national targets: for employment; for research and innovation; for climate change and energy; for education; and for combating poverty. They represent the direction the EU should take and where success should be measured.

In annex 1 of the Communication on the Europe 2020 strategy an overview table is provided, with the three mutually reinforcing priorities (Smart Growth, Sustainable Growth, Inclusive Growth) further divided into seven flagship initiatives. The seven flagships are described in the table below.

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The Commission is putting forward these seven flagship initiatives, among them the below-mentioned Innovation Union, to catalyse progress under each priority theme.

Flagship Initiative: "Innovation Union"

The aim of this is to re-focus R&D and innovation policy on the challenges facing our society, such as climate change, energy and resource efficiency, health and demographic change. Every link should be strengthened in the innovation chain, from 'blue sky' research to commercialisation.

At EU level, the Commission will work:

- To complete the European Research Area to develop a strategic research agenda focused on challenges such as energy security, transport, climate change and resource efficiency, health and ageing, environmentally-friendly production methods and land management, and to enhance joint programming with Member States and regions;

- To improve framework conditions for business to innovate (i.e. create the single EU Patent and a specialised Patent Court, modernise the framework of copyright and trademarks, improve access of SMEs to Intellectual Property Protection, speed up setting of interoperable standards; improve access to capital and make full use of demand side policies, e.g. through public procurement and smart regulation);

- To launch 'European Innovation Partnerships' between the EU and national levels to speed up the development and deployment of the technologies needed to meet the challenges identified. The first will include: building the bio-economy by 2020, 'the key enabling technologies to shape Europe's industrial future' and 'technologies to allow older people to live independently and be active in society';

- To strengthen and further develop the role of EU instruments to support innovation (e.g. structural funds, rural development funds, R&D framework programme, CIP, SET plan), including through closer work with the EIB and streamline administrative procedures to facilitate access to funding, particularly for SMEs and to bring in innovative incentive mechanisms linked to the carbon market, namely for fastmovers;
To promote knowledge partnerships and strengthen links between education, business, research and innovation, including through the EIT, and to promote entrepreneurship by supporting Young Innovative Companies.

At national level, Member States will need:

- To reform national (and regional) R&D and innovation systems to foster excellence and smart specialisation, reinforce cooperation between universities, research and business, implement joint programming and enhance cross-border co-operation in areas with EU value added and adjust national funding procedures accordingly, to ensure the diffusion of technology across the EU territory;
- To ensure a sufficient supply of science, maths and engineering graduates and to focus school curricula on creativity, innovation, and entrepreneurship;
- To prioritise knowledge expenditure, including by using tax incentives and other financial instruments to promote greater private R&D investments.

http://ec.europa.eu/europe2020/

2.2. EC Communication on Innovation Union

Research and innovation have a critical role to play in the creation of economic prosperity and the resolution of major societal challenges, and win-win policies designed to stimulate the economy and tackle major societal challenges are both viable and desirable.

At a time of public budget constraints, major demographic changes and increasing global competition, Europe's competitiveness, our capacity to create millions of new jobs to replace those lost in the crisis and, overall, our future standard of living depends on our ability to drive innovation in products, services, business and social processes and models. This is why innovation has been placed at the heart of the Europe 2020 strategy. Innovation is also our best means of successfully tackling major societal challenges, such as climate change, energy and resource scarcity, health and ageing, which are becoming more urgent by the day.

The list of major societal challenges that urgently need to be confronted is daunting. The problem of scarce energy resources has to be resolved, our environment has to be safeguarded and growth has to be sustainable. New security threats have to be countered and adequate supplies of food guaranteed. The changing needs of an ageing society also have to be met as our demographic profile continues to evolve, and society has to be continually on its guard against both new and old threats to the health of its citizens.

Europe is faced with a number of major societal challenges such as an ageing population, the effects of climate change, and reduced availability of resources. Breakthroughs must be found in new treatments for life-threatening diseases, new solutions to improve the lives of elder people, ways to radically cut CO2 emissions and other sources of pollution in particular in cities, alternative sources of energy and substitutes for increasingly scarce raw materials, reducing and recycling waste and ending landfill, improvements in the quality of our water supply, smart transport with less congestion, healthy or high-quality food stuffs using sustainable production methods and technologies for fast and secure information handling and sharing, communication and interfacing.

Successfully developing these breakthroughs will also boost our competitiveness, enable European companies to lead in the development of new technologies, to grow and assume global leadership in new growth markets.

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improve the quality and efficiency of public services and so contribute to creating large numbers of new quality jobs.

Given the scale and urgency of the societal challenges and the scarcity of resources, Europe cannot afford any longer the current fragmentation of effort and slow pace of change. Efforts and expertise on research and innovation must be pooled and critical mass achieved. At the same time, we must from the outset put in place the conditions which allow breakthroughs quickly to find their way to the market, thereby bringing rapid benefits to citizens and competitiveness gains.

For these reasons, the Commission in its Europe 2020 Strategy announced that it will launch, as part of the Innovation Union flagship initiative, European Innovation Partnerships. These Partnerships will test a new approach to EU research and innovation.

With a view to achieve the EU 2020 objective of a smart, sustainable and inclusive growth, the Commission intends to launch innovation partnerships in key areas addressing major societal challenges, such as energy security, transport, climate change and resource efficiency, health and ageing, environmentally-friendly production methods and land management.

Examples of possible partnerships include areas such as:

- Tackling the major climate change & energy challenge coming from cities (which consume around 80% of the overall EU energy and are responsible for about the same share of greenhouse gases) by creating a representative platform of key stakeholders and boost the use of existing and future ICT to accelerate the deployment of smart grids, new systems for using energy from renewable source, smarter & cleaner urban mobility, increased energy efficiency of buildings;

- Ensuring higher quality and efficiency of our supply use of water;

- Ensuring a secure supply chain and achieve efficient and sustainable management and use of non-energy raw materials along the entire value chain;

- Reducing emissions of greenhouse gases by higher emission efficiency of transport also beyond the urban dimension, notably through inter-operable and intelligent traffic management systems across all transport modes, leading to progress in logistics and behavioural changes.

- Promote EU's competitiveness in the digital society through faster access to information and new ways of trustworthy communication, interfacing and knowledge sharing enabled notably by the internet of the future.

- Improving the supply of foodstuffs produced in a resource-efficient, productive and low emission way through improved agricultural and food-processing methods.

- Improving the quality of life of an ageing population e.g. by new innovative solutions, clinical tests, diagnostics and treatments for age-related diseases, deployment of new innovative ICT-based solutions and the development and introduction of novel products, appliances and services specifically suitable for the elderly.

Preparatory work has been undertaken on launching specific partnerships in active and healthy ageing, water efficiency, non-energy raw materials, smart mobility, agricultural productivity and sustainability, and on smart, liveable cities, the latter combining energy efficiency, clean transport and fast internet.

- Pilot European Innovation Partnership in the field of active and healthy ageing

The aims of the innovation partnership are, by 2020, to enable our citizens to live longer independently in good health by increasing the average number of healthy life years by 2, and, in achieving this target, to improve the
sustainability and efficiency of our social and healthcare systems, and to create an EU and global market for
innovative products and services with new opportunities for EU business.

Further potential Innovation Partnerships so far examined by the Commission:

- **Smart Cities**
  By 2020, and taking 2010 as a baseline, the aim is to support a number of pioneering European cities (with a
total population of at least 20 million) in reducing their carbon emissions by more than 20%, increasing the
share of renewable energy in the energy used for electricity supply, heating and cooling by 20%, and increasing
end-use energy efficiency by 20%. The Partnership will demonstrate the feasibility of rapid progress towards
the EU's energy and climate objectives at local level while showing citizens that their quality of life and local
economies can be improved through investments in energy efficiency, renewable energy sources and energy
system management solutions, including smart metering and use of ICT innovations as well as more efficient
urban transport.

- **Water-Efficient Europe**
  The aim of the Partnership is to promote actions that can speed-up innovation in the water sector and remove
barriers to innovation. The actions are intended to achieve the EU water policy objectives while reducing the
EU water footprint, improving water security and promoting the worldwide leadership of the European water
industry.

- **Sustainable supply of non-energy raw materials for a Modern Society**
  The aim is to ensure a secure supply and achieve efficient and sustainable management and use of non-energy
materials along the entire value chain in Europe. This is all the more necessary to provide an answer to the
various societal challenges at stake. Demonstrating ten innovative pilot plants for raw materials extraction,
processing and recycling, and finding substitutes for at least three key applications of critical raw materials
underpin this Partnership.

- **Smart mobility for Europe's citizens and businesses**
  The aim of the Partnership is to equip Europe with seamless door-to-door travel and effective logistics by
promoting the broad and coordinated development and deployment of Intelligent Transport Systems (ITS).
The Innovation Partnership will build on available results from research and development and take them
further to innovation and concrete operational deployment, combined with further research, policy and
legislative measures.

- **Agricultural productivity and sustainability**
  World food demand will increase massively over the next two decades. The aim of this Partnership is to
promote a resource-efficient, productive and low-emission agricultural sector – which works in harmony with
the essential natural resources on which farming depends, such as soil and water. The objective is to deliver a
safe and steady supply of food, feed and biomaterials – both existing products and new ones. There is a need to
improve processes to preserve our environment, adapt to climate change and mitigate it. The Partnerships
would build a bridge between cutting-edge research and technology and the farmers, businesses and advisory
services which need them.

http://ec.europa.eu/research/innovation-union/
2.3. The World in 2025

“The World in 2025” first underlines the major future trends: geopolitical transformations in terms of population, economic development, international trade or poverty. Secondly, it elucidates the tensions: natural resources (food, energy, water and minerals), migrations or urbanisation. Lastly, transitional pathways have been drawn: towards a multi-polar world and world governance, towards a "large integrated Europe" and a "global Europe", towards a new "socio-ecological" production and consumption model, towards new rural-urban dynamics, towards a new gender and intergenerational (incl. active ageing) balance. In summary, the sub-title of this publication “Rising Asia and socio-ecological transition” is explicit and could be an inspiring source for the future strategy of the European Union.


2.4. Facing the future: time for the EU to meet global challenges

There is a clear and growing need for the capacity to anticipate change to be embedded in policy. This is critical not only to be able to respond and adapt to new situations before they occur, but also to shape the future, building upon mutual understanding and common visions to be jointly pursued. For policy responses to address all the pressing current global challenges, especially when these are seen separately from one another, is clearly a demanding task. Institutions face greater complexity and difficulty in providing solutions in due time. In particular, this is true when the policy focus extends beyond the challenges that societies face today, seeking to anticipate future challenges and transform them into opportunities.

The aim of “Facing the future: time for the EU to meet global challenges” is to provide a comprehensive picture of the main trends ahead and possible future disruptive global challenges, and to examine how the EU could position itself to take an active role in shaping a response to them. The work described in this report brings a fresh perspective, by linking widely accepted quantified trends towards 2025 and beyond with experts’ and policy makers’ opinions on the likely consequences of these trends and wild cards.

The methodology used combines an extensive analytical review of recent future oriented studies, followed by a wide online consultation of the identified issues, and use of multi-criteria quantitative analysis (Robust Portfolio Modelling) to prioritise the resulting issues. Key issues were then presented and discussed in a workshop with selected experts and policy makers.

Based on the criteria of urgency, tractability and impact, the expert workshop identified three challenges with a global scope, but which require action at EU level, to be selected. These are:

- The need to change current ways in which essential natural resources are used – due to the non-sustainable human over-exploitation of natural resources. The most well known effects are: climate change; loss of biodiversity; increasing demand for food; deepening poverty and exclusion due to continued exploitation of the natural resources; energy and water scarcity leading to competition and conflict; mass migration and threats in the form of radicalisation and terrorism.

- The need to anticipate and adapt to societal changes – including political, cultural, demographic and economic transformations in order for the EU to develop into a knowledge society. The main dimensions related to this challenge are: economic growth mainly depending on increases in productivity; ageing societies increasing pressures on pensions, social security and healthcare systems; flows of migrants from developing to developed countries; empowerment of citizens through enhanced education; barriers to the social acceptance of innovations due to lack of understanding of
technological possibilities and related consequences; and inability to keep up with the speed and complexity of socio-economic changes.

- The need for more effective and transparent governance for the EU and the world – with the creation of more transparent and accountable forms of governance able to anticipate and adapt to the future and thus address common challenges, and to spread democracy and transparency on the global level. Related to this challenge are: the fading of borders between nations with the problems of (especially neighbouring) developing countries increasingly affecting the EU; single policy governance approaches which can no longer cope with global issues; and the lack of balance in representing nations in global fora.

The report brings to the forefront three interrelated challenges for the EU and the world, and offers options to transform them into opportunities for long-term EU policy making. Improving citizens’ empowerment and participation through the increased use of Information and Communication Technologies, searching for greater policy alignment towards sustainability, and establishing global partnerships between industry, government and society to build shared values and common visions on the future are among the key messages for EU policy makers.


2.5. Joint Programming

Investing in research today ensures a better tomorrow, both for ourselves and for future generations. Europe not only needs to invest more in research, but also needs to invest it to better effect, if it is to achieve its declared vision: a balanced and sustainable development, marrying economic growth and competition with high levels of quality of life and the environment we live in, and ensuring an effective EU for the benefit of citizens in all Member States.

The Lisbon Strategy recognised this by setting as its most urgent objective the transition to a knowledge-based society - with science, technology and innovation at its heart - and by calling for more and better investment in research. Europe must renew its efforts if it is to succeed. Above all, it must be prepared to think courageously and innovatively about how it organises its research.

The most predominant interest of the active ERA-NETs is according to Elena (2010) on scientific or technical domains (such as nanotechnology or chemistry). Moreover, around 15% of the ERA-NETs with a unique focus concentrate their interest on specific policy areas generally related to grand societal challenges (such as water or climate change), on industry sectors (related to applied research in fields such as transport or food production) or on the development of particular regions (e.g. Mediterranean or Balkan areas).

Joint Programming involves Member States engaging voluntarily and on a variable-geometry basis in the definition, development and implementation of common strategic research agendas based on a common vision of how to address major societal challenges. It may involve strategic collaboration between existing national programmes or jointly planning and setting up entirely new ones.

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X-axis: This estimates the degree of coordination among Member State (MS) research programmes and of funding and institutional fragmentation, based on qualitative assessments from scientific publications, strategic reports, etc;

Y-axis: This presents the logarithmic ratio of public R&D investment in Europe (MS+European Commission (EC)) compared to US;

Size of bubbles: This is directly proportional to the amount of European public funding (MS+EC), based on New Cronos (e.g. GBAORD) and US government data as well as scientific publications.

Ideally, some research fields should have been further disaggregated. The biotechnology bubble, for example, should have been divided into health, industrial & environment and plant, animal and food. This was not always possible due to a lack of comparable data.

How Europe responds to a number of major societal challenges will shape its future in the decades to come. These challenges include sustaining Europe's prosperity in the face of increased global competition; dealing with the needs of its ageing population and the challenges of immigration; and stimulating sustainable development, especially in the context of climate change, securing the supply of energy, preserving human and environmental health, ensuring food quality and availability as well as safeguarding citizen security.

S&T fields differ hugely in terms of, for example, the amount of R&D invested, the degree of existing coordination/fragmentation and performance – and there is no straightforward linear relationship between these factors. The graph above shows the size of public funding, an assessment of the degree of coordination/fragmentation at European level, and the relative size of European public funding compared to the US for some S&T fields. The graph is not exhaustive, but serves to illustrate that each S&T field is unique and requires its own tailored approach to Joint Programming, the development of which should be evidence-based and grounded in the strategic analysis of detailed information on respective S&T fields.

On 3rd December 2009 the Council of Ministers adopted a pilot Joint Programming Initiative on Neurodegenerative diseases (including Alzheimer's disease). In these same Conclusions, the Council asked the Commission to develop proposals in three new areas identified by the GPC.
In April 2010 the Commission responded to the above demand putting forward Commission recommendations inviting Member States to launch Joint Programming Initiatives in these three areas, accompanying each of them with full States of Play for research in Europe in these areas:

- Agriculture, Food security and Climate Change
- Cultural Heritage and Global Change: a new challenge for Europe
- A Healthy Diet for a Healthy Life

http://intranet-rtd.rtd.cec.eu.int/jointprogramming.html#5
http://ec.europa.eu/research/era/areas/programming/joint_programming_en.htm

2.6. Towards FP8

The preparation of FP8 focuses currently on structural aspects mainly. Topics are for the moment only in a general and broad sense discussed. More insight into future topics is available at sectoral DGs and thematic directorates of DG Research. A compilation of contributions to the FP8 preparation is accessible e.g. at the below-mentioned web-site.

http://www.czelo.cz/fp8-preparation/

It is expected that the FP8 Space theme will continue to address research in support of Earth observation, for example through the development of new enabling technologies such as new Earth observation sensors or new data processing methodologies.

Europe should build on its tradition of cooperation in space research and exploration to become a major player in the global exploration initiative and take a leading role for a series of significant exploration missions to Mars (esp. in the frame of MSR) and other solar system bodies. Europe shall prepare the operational capabilities and infrastructures enabling future robotic and human exploration of Mars and other solar system bodies.

http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=6214

The following topics would be most relevant for future health activities and FP8 Health:

- Actions against cancer and for personalized medicine
- Demographic change and ageing population (healthy ageing, service provision, ...)
- Financing of Healthcare System (rising costs, cost-effectiveness, ...)
- Health workforce
- Health for disadvantaged groups (migrant health, ...)
- Personalized healthcare
- New technologies (e-Health, medical devices, ...)
- Prevention / Lifestyle related issues / Chronic Diseases
- Coordination of health care, multidisciplinarity, cross-sectoral cooperation, ...


In ICT, Future and Emerging Technologies (FET) is a forerunner of mainstream and industrial research agendas worldwide and influences the way foundational multidisciplinary research is supported and organised. Europe should coordinate national and EU-level efforts more closely to identify and support shared research
priorities emerging from European research roadmaps. This includes the possibility of launching joint initiatives by Member States in domains of common interest where national initiatives exist. They could focus initially on domains such as quantum and neuro-information technologies where European research roadmaps exist and then be gradually extended to other fields.


The first of the seven EU flagship initiatives concerns the Digital Agenda for Europe (DAE), launched with a Commission Communication in May 2010.


DG Energy has run a public consultation from May-July 2010 on its future energy policy from 2011 up to the year 2020. Results of the consultation have been summarised in a Commission document (see weblink below).

There was a broad agreement for promotion of technological development. The implementation of the SET Plan and related European Industrial Initiatives should be the core of EU’s low carbon technology policy.

There was also a common view on the need for a new approach for the EU infrastructure energy policy. The forthcoming Energy Infrastructure Package was seen as an opportunity to present a strategic analysis and proposals for the future EU energy network. While there was agreement on the need to decarbonise our energy system, a variety of views emerged on quantified targets and diverse views were expressed on the most efficient policy initiatives to decarbonise our energy system. Various views on the most efficient way to decarbonise our energy system:

- energy efficiency and renewables,
- increased penetration of natural gas,
- innovation and technology,
- fossil fuels with Carbon Capture and Storage,
- nuclear,
- ETS and energy/CO2 taxes.

http://ec.europa.eu/energy/strategies/consultations/2010_07_02_energy_strategy_en.htm

In the field of Knowledge Based BioEconomy (KBBE, covering agriculture, food and biotechnology), preparations for future directions are ongoing in early 2011 through a foresight study (based on a meta-review of foresight exercises in Europe), through a public consultation and through various conferences on KBBE in FP8.

The foresight study focuses on agriculture and food production. It suggests research on raising the productivity of agriculture in a sustainable manner and increasing the resilience of systems to deliver food security, feed, fuel, fibre and other ecosystem services under current and future climate and resource availability.


The background paper for the September 2010 KBBE conference puts includes biotechnology and outlines the following priorities among others:

- sustainable feedstock production, for food and non-food applications
- methods of improving feedstock yields and/or the composition of biomass for optimal conversion efficiency: through research into plant genomics and new breeding programmes, and also research into efficient crop rotation, land management and land-use change issues
- advanced breeding technologies and green biotechnology
- health impacts of nutrition and lifestyle
- increasing efficiency and reducing waste throughout the food chain
- innovative bio-based products: bioenergy (including biofuels), bioplastics
- develop efficient and robust enzymes, particularly for the conversion of lignocellulosic material from a variety of feedstock
- Synthetic biology and metabolic pathway engineering for the development of “microbial cell factories”,
- combination of technologies such as biochemical and chemical processes


Issues such as sustainable consumption, zero-waste society, effects of water shortages, reduction of greenhouse gas emissions are tested in a public consultation by the European Commission.

For Aeronautics/Aviation research, the European Commission has published in 2011 the vision for Europe’s aviation: Flightpath 2050, a report by the High Level Group on Aviation Research:


It outlines the following topics as relevant for the long term vision up to 2050:
- Energy supply, sustainable alternative fuels
- Reducing CO2 emissions
- Noise reduction
- Recyclable air vehicles
- Atmospheric research
- Improved safety and security

The Advisory Council for Aeronautics Research in Europe (ACARE) has published a position paper to FP8, where the following topics are outlined:
- eco-efficient flying
- passenger treatment throughout the journey from door-to-door brought about by dedicated infrastructure and vehicles
- Integrated Transport Systems


NMP – Nanotechnology, Materials, Production Technologies

In NMP a detailed report of the FP7 expert group looks at short term priorities for NMP research up to 2015:


General remarks on nanotechnology perspectives up to 2025 were made at the last EU conference on industrial technologies in autumn 2010 in a keynote speech:


The following nanotechnology perspectives were outlined:
2.7. Germany: New future research fields

The most recent German Foresight (2007-10) followed a twofold approach: first to find out future topics in established thematic fields, and second to find out new future thematic fields. Two different studies were prepared accordingly.

The starting point for this foresight process was the 17 thematic fields of the German High-tech Strategy and ongoing foresight activities in the departments, i.e. the BMBF’s portfolio. By mid-2009, a set of advanced methods of future research had been developed to identify new research and technology focuses in 14 selected established future fields. This resulted in the so-called future topics in the areas of health research, mobility, energy, environment and sustainable development, industrial production systems, information and communications technology, life sciences and biotechnology, nanotechnology, materials, substances and their manufacturing processes, neurosciences and learning research, optical technologies, services science, systems and complexity research, and water infrastructures.

The future topics were analysed in several steps, discussed with national and international experts, then evaluated and sorted. In the course of this evaluation, the extent to which the research prospects and structure of the future topics are stable or still in flux was asked about. The topics were then selected, after being measured against the questions formulated at the outset.
Investigations into the established future fields were also a necessary precondition in pursuing the central objectives of the BMBF Foresight Process. The identification of cross-sectoral aspects and research in the established fields provided initial starting points for interdisciplinary activities and for indicating areas outside current specialist logic and programme structures that are at the interfaces between individual disciplines over the further course of the process. Structures in fields that were identified in many specialist programmes as important for R&D, but whose connecting structures were often not discernible to experts, were derived from the overall survey of the various methods such as bibliometrics, monitoring, inventor scouting and the online survey. These areas, covering various research and innovation fields, were repeatedly separately evaluated and validated and continuously modified. Over the course of the process, the following new future fields developed out of this overall survey of the established fields and their future topics:

- Human-technology cooperation, Deciphering Ageing, Sustainable living spaces, Production Consumption 2.0, Trans-disciplinary models and multi-scale simulation, Time research, Sustainable energy solutions

A comparative meta-analysis of foresight studies was commissioned by the German Ministry of Education and Research. The analysis was done over the following countries: France, India, Japan, Spain, UK and USA.

The most pronounced interest for specific themes were shown following this ranking: Energy, Sustainability and Environment, Health and Nutrition, ICT, Transportation and Mobility, Biotechnology and Life Sciences, Defence and Security, Construction and Residence. A continuity in the themes can be observed. However, two developments are highlighted:

1. Energy has gained in interest. While years ago Energy was considered as part of Sustainability and Environment, the attention is now concentrated on this theme. The same increase in interest has been
experienced by Transportation and Mobility as well as Construction and Residence. Both themes have been considered under the aspect of Energy Savings.

2. In general, more application-oriented themes are gaining attention whereas basic technologies are less discussed for their own purpose but more in relation to applications. The interest in Electronics for instance has lost in importance within the technology studies. Same happened with production and process technology, material-technology as well as nano- and microsystem-technology. Regarding the thematic broadness of specific technology prospects, the observation has been confirmed that thematic foresight only is done within countries having little experience in the development of technology prospects.


2.8. France: Future thematic research priorities

Aim of the foresight study „France 2025“, carried out in 2008, was to identify global and national trends in the areas of economy, society, technology and environment in the context of geo-strategic changes. Moreover, options for action were compiled, which would allow France to stay competitive until 2025 with the existing social cohesion (Holtmannspötter et al., 2010).

Regarding S&T and innovation priorities, mature technologies have been identified for 2025, such as management of logistics chain, economic energy consumption, image capture, mobile communication of 4th generation, which would support the basic innovation activities in 2025: sustainable development, earth and ecosystem change, technology for the knowledge society, life sciences and biotechnology, nanotechnology, intelligent materials and new production procedures.

En 2025, quatre grands domaines seront le socle des activités d’innovation technologique

40 technologies émergentes et prioritaires
Caractère émergent ↔ prépondérance de la recherche de base et des activités d’invention (date d’aboutissement de maturité lointaine: au moins 10-15 ans)
Caractère prioritaire ↔ évaluation de son impact potentiel sur quatre domaines (science et technologie, industrie et marchés, environnement, qualité de la vie)

5 technologies matures en 2025
- Gestion de la chaîne logistique
- Technologies du logiciel pour le transport de données numériques
- Consommation plus économe en énergie
- Capteurs d’image
- Communication mobile (téléphonie cellulaire de 4e génération)

Développement durable, changement planétaire et écosystèmes (5 technologies)

Domaines scientifiques qui seront le socle des activités d’innovation en 2025

Nanotechnologies, matériaux intelligents, nouveaux procédés de production (11 technologies)

Sciences du vivant, génomiques et biotechnologies pour la santé (6 technologies)

2025 DATE DE MATURITÉ ATTENDUE 2030

5 technologies

24 technologies

11 technologies
2.9. UK: New future research fields

As an advanced large European country, the UK is active in most areas of science and technology development. Accordingly, thematic areas such as biotechnology, nanotechnology, ICTs, etc. are comprehensively covered across the whole spectrum of Frascati research ‘types’ (by Research Councils and Government Departments). No explicit prioritisation occurs between these thematic areas, but more emphasis may be placed on chosen themes at certain times. For example, over the last 10-15 years, biological sciences have increasingly accounted for a larger proportion of research spending in the UK. This reflects an international trend, whereby the biological sciences have enjoyed large increases in spending whilst increases in the engineering and physical sciences have been more modest (for example, this can be seen in the EC’s Framework Programme). Cuts are rare – rather, new spending increases are assigned to those areas that show the most visible promise. How such promise is constructed and received is well beyond the scope of the short paper presented in Gassler et al. (2004).

![Figure on prioritisation criteria used in the first UK Technology Foresight Programme (2003)](image)

UK Government needs to articulate a long term vision and priorities for development over the next decade or more, which will provide a framework for research investment by the private sector, the Research Councils and the Technology Strategy Board (TSB). This should focus on a number of key strategic areas, for example:

- technologies underpinning 21st century national infrastructure
- solving major global problems, for example climate change and shifting resources to those areas where the UK has capability to build new industries, for example green technologies, the creative industries or plastic electronics
- addressing major social challenges including food security, healthcare and an ageing population

The Research Councils and the TSB should consider how to build on recent initiatives to coordinate major translational activities under a joint banner and, as resources become available, achieve greater critical mass in selected areas by a smaller number of longer-term funded developmental centres combining the best of the TSB Innovation Platforms and the Research Councils’ Innovation and Knowledge Centres (CST, 2010)).
3. Analysis of S&T priorities for the Russian Federation

The analysis of S&T priorities for the Russian Federation is based on the results of S&T Foresight studies and expert assessments conducted in the framework of revising the lists of National S&T priorities and Critical Technologies of the Russian Federation in 2009-2010 as well as on the results of the Delphi Study (National S&T Foresight 2025).

Russia’s national S&T priority development areas include the following:

- Nanosystems;
- Information and Telecommunication Systems;
- Life Sciences;
- Efficient Nature Management;
- Transport and Aerospace Systems;
- Power Efficiency and Power Saving

3.1. Nanosystems

**Nanosystems** R&D products have a very wide range of applications: metallurgy, chemical industry, agriculture, mechanical engineering, health, power industry, environment protection etc. These technologies allow saving material, labour and power costs, increase national security and defence potential.

Development of technologies in this area will help manufacture important products with improved consumer properties, reduced maintenance and repair costs – contributing to increased competitiveness of domestic manufacturers. Such products include bio-compatible and bio-degradable materials, sorbents, nanoceramics for optical and photonic devices, magnetic composites, polymer and polymer-fibre composite, coatings with specific properties, catalysts, membranes, materials for sensor, optic and photoelectronic devices, hybrid and flameproof materials, metamaterials, nanopowders etc. Such products can be used to make materials, parts and structures for use in extreme environments (e.g. rockets and spacecraft), in mechanical engineering, medical equipment, various civil products, in construction etc., as well as in instrumentation and supportive materials in micro- and optoelectronics, power generation, for dealing with environment-related problems etc.

R&D products in this area will contribute to creation of new-generation machinery and equipment and artificial intelligence, among other things for use in robotic complexes.

3.2. Information and Communication Systems

Research and development products and innovations in the Information and Telecommunication Systems area are actively used to build information systems and communication networks, to provide medical and social services to people, and in defence industry. Further development of these technologies will help to reduce technological dependence on foreign manufacturers, contribute to emergence of new labour markets and increased motivation for Russian professionals to work in the Russian economy, primarily by creating super-computer hardware and software, powerful computing and communication...
devices leading to emergence of distributed computing networks (cloud computing) and super-computer resources.

Technologies relating to this area are actively used in various industries – to increase power-and resource efficiency, production of advanced, competitive weapons, increased safety of transportation systems, more efficient diagnostics and treatment of socially important diseases, etc.

Further development of such technologies would contribute to industrial production and application of a wide range of microchips required to make powerful computers, radioelectronic equipment, and various telecommunication devices including space-based and military ones. Also, progress in the area of information and telecommunication systems would contribute to emergence of infrastructure, equipment, algorithms and software for general-purpose and specialised information and communication systems.

3.3. Life Sciences

Innovative products in the Life Systems category are actively used in pharmaceutical industry, health, veterinary medicine, bio-security. Further development of such technologies would contribute to emergence of more efficient treatments, safer drugs with reduced side effects, new, faster and more efficient diagnostic systems – leading, in turn, to bigger markets for domestic products and import substitution. Progress in this area would also improve the country’s defence potential: some of the pharmacological substances (specialised and double-purpose ones) could protect the military and civilians from weapons of mass destruction, epidemic diseases and possible bio-terrorist attacks.

3.4. Efficient Nature Management

Efficient Nature Management technologies are actively used in the fuel and power-generation complex, agriculture, fisheries, mining, development of new transport systems and, of course, for environment protection and health purposes. Further development and application of these technologies would contribute to the country’s ecological security, increased resource potential, more efficient extraction of natural resources, reduced risks of disasters and accidents, sustainable use of bio-resources. It would also contribute to increasing national defence potential.

Efficient nature management technologies help to reduce social, economic and environmental costs of natural and anthropogenic disasters, to make the environment more healthy and favourable. In turn, development of prospecting and extraction technologies, including those for hard-to-mine and “leftover” resources, increase efficiency and contribute to innovative development of oil, gas and coal industries.

Further development of this field would help to increase the resource base for metallurgical, chemical and construction materials industries – through emergence of new technologies for extraction and processing of hard-to-enrich complex mineral and artificial raw materials, increase power efficiency of mainline production processes in mining and related industries.
3.5. Transport and Aerospace Systems

R&D and innovations in the **Transport and Aerospace Systems** category are actively used to create new transport complexes including aerospace, railway, automobile and water transport. Such systems are also used for prospecting, navigation support, in emergency situations, for environment monitoring, communication etc.

Further development of transport and aerospace systems would help to increase efficiency and effectiveness of shipping and transportation operations - by reducing fuel consumption and maintenance costs, increasing safety and capacity of transport systems and infrastructure. This can be achieved by reducing delays and increasing the speed of all kinds of transport systems by introducing an integrated real-time traffic management system supported by radically improved information flows and various related services, available to all participants of transport networks.

Further progress in this area would contribute to reducing the amount of time and effort needed to manufacture products for transport and space industries. In particular, it would help to create highly durable, environmentally neutral, fireproof, anticorrosion, high-strength materials with specific properties, for use in transport, industrial and civil construction; such materials would increase safety at industrial enterprises, transport and households; contribute to reliable functioning of transport systems throughout their prolonged lifecycle. Development of this field also implies development of technologies aimed at saving hydrocarbon reserves by reducing consumption of electricity and thermal energy; reducing waste associated with conversion of thermal, chemical and electric energy into useful work; and reducing emission of harmful substances during manufacturing, operation and disposal of transport vehicles.

3.6. Power Efficiency and Power Saving

R&D results in the **Power Efficiency and Power Saving** area are used in the power generation complex, environment protection, utilities, agriculture, mining and transport industries.

Application of new technologies in this field would help to significantly reduce power consumption, ensure sustainable power supply, increase the country’s economic and defence potential, reduce environment pollution, raise standard of living, create comfortable conditions for people’s life and work.

This will be achieved by diversifying power sources; accelerated development of S&T potential; increased share of nuclear power generation sector and increased range of nuclear energy applications including electricity, thermal energy for use in utilities and industrial sectors; production of new types of fuel including hydrogen; nuclear fuel breeding and closing of nuclear fuel cycle; production of electrical and thermal power at organic fuel plants of various capacity; building new and upgrading existing sustainable-source power plants; application and development of advanced thermal power generation technologies to increase efficiency, reliability, safety and environment friendliness of Russian power transmission, distribution and consumption networks (both for electrical and thermal energy).
3.7. Critical Technologies

Critical technologies for priority R&D areas:

1. Nanosystems
   1) Computer simulation of nanomaterials, nanodevices and nanotechnologies
   2) Nano, bio-, info-, cognitive technologies (NBIC technologies)
   3) Diagnostic technologies for nanomaterials and nanodevices
   4) Technologies for making and processing construction nanomaterials
   5) Technologies for making and processing functional nanomaterials
   6) Technologies for making and operating nanodevices

2. Information and telecommunication systems
   1) Technologies providing access to broadband multimedia services
   2) Technologies for information, management and navigation systems
   3) Technologies and software for distributed high-performance computing systems
   4) Technologies for creating electronic component bases

3. Life sciences
   1) Biomedical and veterinary technologies
   2) Bio-catalytic, bio-synthetic and bio-sensor technologies
   3) Genome, proteome and post-genome technologies
   4) Cellular technologies
   5) Bio-engineering technologies
   6) Technologies for reducing waste from socially significant diseases

4. Efficient nature management
   1) Technologies for preventing and cleaning up environment pollution, monitoring the state of environment and forecasting its development
   2) Technologies for preventing natural and anthropogenic disasters and dealing with their consequences
   3) Technologies for searching, prospecting, mining and processing natural resources

5. Transport and Aerospace systems;
   1) Global security technologies based on common transport and information space
   2) Technologies for making high-speed vehicles and intelligent control systems for new types of transport
   3) Technologies for making power-efficient, environmentally friendly new-generation transport vehicles and systems

6. Power efficiency and power saving
   1) Nuclear power technologies, nuclear fuel cycle, safe treatment of radioactive waste and depleted nuclear fuel
2) New and sustainable power sources technologies, including hydrogen-based power generation
3) Technologies for making efficient power transmission, distribution and consumption systems
4) Technologies for efficient production and conversion of power based on organic fuel

Below is a brief description of the current R&D level for a modified list of critical technologies.

The R&D level in Nanosystems category is generally high, on a par with the world leaders.

This category includes six critical technologies:

1. Computer simulation of nanomaterials, nanodevices and nanotechnologies

Regarding this technology, the most advanced R&D results have been achieved in the area of multi-scale simulation of nanomaterials’ properties and nanostructured elements; nanostructures visualisation techniques; and simulation of nanostructures and nanostructure ensembles’ self-assembly from molecules, molecular complexes and liquid-stage nanoparticles. There’re significant advances in developing application suites for such simulation techniques.

Among the least developed, are first-principle simulation techniques for nano-electronic devices; software for virtual design of nanostructures with specific properties; and distributed computing and parallel calculations for multi-scale simulation of complex systems.

2. Nano, bio-, info-, cognitive technologies (NBIC technologies)

In this area, active R&D are under way to work out principles of integrating biological and technological systems; development of principles and technologies for hybrid anthropomorphic systems; nanometre/femtosecond resolution systems to visualise and analyse biological objects. The results in these areas are on a par with the best international achievements. Promising R&D areas in this group of technologies also include original substances for stimulation and restoration of damaged cognitive functions; cluster nanotechnology systems for analysis and diagnostics of hybrid nanosystems; nanometre resolution systems for visualisation and analysis of biological objects; nanoscopes.

Russian researchers significantly lag behind the world leaders in development of hybrid neuro-electronic devices; neuro-visualisation of cognitive processes; and systems (including computers) based on neuro-morphic principles.

3. Diagnostic technologies for nanomaterials and nanodevices

This technology has high-level R&D in the area of highly sensitive integrated nano- and micro-sensors for consumption control; micro-robotic systems; various-purpose photoelectronic systems. There are good advances in designing micro- and nano-sensors to monitor pressure, temperature, consumption of liquids and gases; micro- and nano-analysers for composition and properties of substances; integrated nano- and micro-mechanical sensor systems for mechatronic products.
Insufficient R&D results in this area have been noted in creating nanosystems for alternative power generation technologies; measuring nanosystems to monitor the state of environment; nano-electromechanical systems for research instruments and equipment; optoelectronics; communication and radio location systems, including memory chips, micro-antennae etc.

4. Technologies for making and processing construction nanomaterials

In this area, there’re promising advances regarding making and processing nanostructured steels and alloys; heat-resistant materials; high-strength magnetic nanomaterials; and nanostructured bio-compatible titanic alloys with reduced module of elasticity, for making new-generation medical implants; high-strength nanoceramics; and composite non-organic-based nanomaterials. There’s advanced research in the area of basic construction materials in the form of powders, nanofibres, nanowires and amorphous films.

R&D in the area of composite ceramic-matrix materials based on oxygen-free compounds, and integrated technologies for adjusting surfaces of materials’ and products’ crystal structures, are below the top world level.

5. Technologies for making and processing functional nanomaterials

Russian R&D in this area match the top world level in such fields as nanoparticles with modified surface layers - for making sensor materials; multilayer optics, functional coatings for micro-electromechanical systems and sensors; highly efficient catalysts for petrochemical and other important industrial processes; construction nanoplastics; nanoceramic alloys for making instruments.

The least developed are such areas as express diagnostics using nanomaterials; composite ceramo-matrix materials based on oxygen-free compounds; catalysts for hydrofining of heavy oil fractions; biodegradable polymers; metal-ceramics for making instruments; self-organising intelligent bio-compatible nanostructured materials.

6. Technologies for making and operating nanodevices

In certain fields of this critical technology Russian researchers are on a par with the leading international centres, or even ahead of them: e.g. probe atomic-force microscopy; sources of terahertz high-luminance radiation, NMR tomography and diagnostic techniques based on X-rays, synchrotron and neutron emission.

However, they significantly lag behind in such areas as high-resolution electron microscopy and sample preparation devices; neutron diffractometers, photoelectron spectroscopy equipment, and devices for measuring bulk local, magnetic and electro-physical properties of nanostructures.

Most promising areas for Russian R&D in the Nanosystems category include the following:

- hybrid systems technologies based on interfacing biological and nanotechnology elements and materials
- technologies for making bio-inspired and hybrid medicinal compounds
- genetic-level nano-immunology and personal medicine technologies
- technologies for making in-vivo molecular processes visualisation systems
- technologies for visualisation of nano-objects (electron, tunnel, atomic-force, magnetic-force, luminescent microscopy, close-type light microscopy etc.)
- structure analysis techniques (diffraction and scatterometry of X-ray, synchrotron and neutron emission); local structure and chemical analysis of nanoparticles and nanomaterials (NMR, EPR, IR- and Raman scattering spectroscopy, EXAFS, XAS, Mössbauer, terahertz spectroscopy, local and layer-by-layer analysis techniques, etc.)
- special techniques for studying nanomaterials’ physical properties (resistometry, magnetic measurement, research of mechanical, tribological properties etc.)
- non-destructive analysis techniques involving nanoparticles and nanomaterials (in-situ and operando modes) (synthesis including self-assembly, adjustment and restructuring of nanoparticles, degrading, chemical processes involving nanoparticles, etc.)
- nanostructuring technologies through high-precision thermal and thermo mechanical processing
- technology for manufacturing and processing nanostructured metallic materials with increased construction and functional properties, for various types of transport vehicles
- nanostructuring technologies based on fragmentation accompanied by intensive plastic deformation
- nanopowder compaction technology
- technology for making and processing construction, instrumentation and multi-layered nanostructures steels and alloys
- technology for making and processing heat-resistant nanostructured materials, including based on intermetallic systems
- technology for making and processing nano-size particles (structures) of different forms; fibres; film structures; voluminous nanostructured materials
- technology for making catalytically active nanomaterials, nano-selective membranes and nano-porous sorbents
- technology for making and processing nanostructured and nano-adjusted polymer materials with special functional properties
- technology for making products of nanostructured composite and ceramic materials
- technology for making nanostructured biocompatible materials
- technology for making nano- and microsystems, devices and components
- technology for making quantum mechatronic systems to control movement of micro- and nano-size objects
- technology for making nano- and micro-sensors
- simulation of structures and properties of functional nanomaterials and their properties
- simulation of construction nanomaterials and their properties
- simulation of electronic, optical, mechanical processes which determine functioning and interaction of nanodevices’ elements
- simulation of various ways of artificial formation of nanomaterials and nanodevices

The level of Russian R&D in Information and Telecommunication Systems category is on average on a par with the top international achievements, or slightly behind them. This area includes four critical technologies:

1. Technologies providing access to broadband multimedia services

Russian R&D in this field are behind the world leaders, in particular in such promising areas as telecommunication systems including subscriber access systems, techniques for managing information processes in communication networks, information security technologies for networks and information systems.

2. Technologies for information, management and navigation systems
Russian scientists’ achievements in this area include specialised encryption protocols; biometric identification technologies; software-based system for generating prints in personal user palette; systems and devices for electronic document management; information security devices and systems, including antivirus applications.

The least developed are such areas as advanced integrated systems for automated production management in mechanical engineering; diagnostics and self-repair technologies for autonomous objects; technologies for controlling autonomous objects in robotics.

3. Technologies and software for distributed high-performance computing systems

Regarding this technology, the most advanced R&D results include systems for processing data obtained in the course of experiments with charged-particle accelerators; access systems for distributed information repositories; SKIF supercomputers and software for them; and teraflop-class supercomputers based on foreign-made components.

Russia most significantly lags behind the world leaders in such fields as microprocessors and communication VLSI for multi-processor teraflop- and petaflop-class supercomputers.

4. Technologies for creating electronic component bases

Advanced Russian R&D results in this area include technologies and equipment for making X-ray mirrors and other lithographer-stepper nodes in the extreme ultraviolet range; metrological devices to control mirror quality; plasma technologies and equipment for etching, coating and ion implantation for making ultra-large-scale integration circuits; technology for making “silicon on insulator” (SOI) wafers and prototype metal-insulator-semiconductor (MIS) nano-transistors with SOI structure; technology for microwave frequency electronics’ component base.

R&D in the field of silicon-based VLSI under 100 nm, microwave frequency electronics’ component base, semiconductor power electronics devices lag behind the top world level.

Most promising areas for Russian R&D in the Information and Telecommunication Systems category include the following:

- technology for making stationary and mobile telecommunication systems including subscriber access systems
- techniques and equipment for high-precision navigation systems based on satellite communications
- techniques and equipment for generating, transmitting and displaying 3D images
- information security technologies
- information security technologies for systems and networks
- techniques for semantic data search in data and knowledge bases
- techniques and software for intelligent decision-making support systems
- parallel computing theory; paradigm and languages for parallel programming; and appropriate software
- instrumentation and processes for development and testing of technologies
- technologies for making ultra-large-scale integration circuits with design rules under 100 nm
- technologies for making super-fast heterojunction integration circuits, including based on resonant tunnelling devices
- technologies for automated design of VLSI and photomask technologies
R&D level in the **Life Sciences** category is rather low, though it’s an extremely important area. It includes six critical technologies:

1. **Biomedical and veterinary technologies**

There are advanced R&D results on a par with the top international level or even above it in this area, e.g. high-tech medical equipment based on tissue-engineered constructions and composites of bio-degradable materials; microbial preparations for use against ectoparasites and carriers of various infectious diseases; antitumour nano-bio-preparations with targeted delivery to specific organs and cells; and immunomodulators based on nucleic acids and their analogies.

However, R&D in such fields as metagenome techniques for human and animal micro-flora analysis, equipment for deep genome sequencing and microchip-based biotechnologies, personified medicine technologies, significantly lag behind the world leaders’ achievements.

2. **Bio-catalytic, bio-synthetic and bio-sensor technologies**

The most advanced, world-level Russian R&D results relating to this technology include enzymes for fine organic synthesis; microbiological synthesis of bio-insecticides; bio-catalytic techniques for eliminating toxins and pollutants; biological microchips for multi-parameter diagnostics; express-tests for use for environment protection purposes, in food industry and at home.

On the other hand, R&D in the area of industrial strains for microbiological synthesis and bio-catalysis; substitution of traditional chemical processes with biotechnologies based on sustainable raw materials and bio-catalysis, significantly lag behind the world leaders.

3. **Genome, proteome and post-genome technologies**

Significant advances have been made regarding development of this technology, on a par with the best international achievements, in particular technologies for making multi-parameter medical diagnostics biochips, approaches to increasing sensitivity of diagnostics equipment by using molecular detectors and molecular colonies method; and mathematical models for metabolic reconstruction and description of complex molecular processes such as splicing, formation of secondary RNA structure etc.

The least developed R&D areas regarding this technology include high-performance technologies for mapping spatial structures of biopolymer complexes required to develop new drugs; and mapping of “large” genomes of eukaryotic organisms – not a single individual genome has so far been sequenced anew.

4. **Cellular technologies**

The most advanced R&D results in this area, above or on a par with the top world level, include technology for transplanting immune-compatible hematopoietic stem cells; self-specific cell preparations and their clinical usage; targeted differentiation of stem cells; and systems for synthesis of signal factors affecting plants’ cell differentiation and organogenesis.
Regarding therapeutic cloning, including cell delineation for substitutive and regeneration therapy; creation of organs and structures out of self-specific cell material for subsequent transplantation; and cellular technologies for treatment of hereditary diseases, Russian R&D lag behind the world leaders.

5. Bio-engineering technologies

There are several promising R&D results in this area, including antitumour nanodrugs (liposomes and immunoliposomes); diagnostic biochips; human lactoferrin obtained from transgenic animals; genetically engineered human insulin; technology for efficient biocatalyst design based on molecular modelling and bioinformatics; and algorithms and programmes for analysing genome and proteome data.

On the other hand, Russian R&D in the area of biotechnological synthesis of polysaccharide with various properties; antitumour drugs; and knock-out animals lag behind the top world level.

6. Technologies for reducing the costs of socially significant diseases

Significant progress has been made in this area, specifically regarding development of multipurpose systems for quick identification of microorganisms and their genetic typing, based on time-of-flight mass spectrometry; design of microchips for analysis of tumour-associated antigens; technology for making liposomes containing antitumor preparations and capable of targeted delivery and prolonged action. Other advanced R&D products include technology for selection of low-molecular inhibitors affecting basic secretion components of pathogenic bacteria.

The least developed R&D areas regarding this technology include manufacturing of mechanical and biological prostheses of cardiac and vascular valves; polymers for surgical treatment of cardiac and vascular aneurysms; diagnostic and treatment systems for X-ray angiographic intervention.

Most promising technological areas in **Live Systems** category for the period until 2030 include the following:

- technology for making instruments and devices for temporary or permanent replacement of physiological functions or organs; technologies for transplanting vital organs; technologies for prolonging useful life of transplanted organs
- technologies for experimental assessment of nanomaterials’ and nanotechnologies’ biological safety, including methodological support and regulatory issues of nano-safety
- technologies for automated multi-parameter molecular diagnostics, to categorise, choose optimal treatment strategies and/or increase personal resistance to harmful external impacts (stress, medication therapy, harmful habits, vaccination etc.)
- technologies for preventing contagion, particularly with dangerous to humans zoogenous infections, including mapping infectious agents’ genomes and developing vaccines/drugs for humans and animals
- technologies for making hardware necessary for surgery, including stents, artificial heart valves, endoscopic systems, electric cardiotistimulators etc.
- technologies for making biological microchips for multi-parameter diagnostics
- technologies for optimising biotechnological production
- biotechnologies for making balanced fodder for animal and poultry farming; enzymes and probiotics for use as fodder additives
• technologies for making portable devices based on highly specific biological recognition principles, for quick diagnostics of various biologically active compounds, marker proteins of somatic and contagious diseases, viruses, microorganisms etc., including for personified medicine and home use
• biosynthesis technologies based on specialised microorganism strains, mammal and plant cell cultures
• technologies for making biosensors to monitor toxic compounds and quality of food stuffs and animal fodder
• metabolic engineering of industrial microorganisms based on genome data; genome mapping of industrial microorganism strains and agricultural plants
• whole genome genetic typing; sequencing and functional annotation of genomes; associated research
• peptidome profiling for diagnostics and design of therapeutic peptidomimetics
• development of low-molecular drugs and biologically active compounds prototypes, including peptides and peptidomimetics; extending indications for drugs approved for clinical use
• technologies for increasing sensitivity and productivity of techniques for detecting proteins in biomaterials
• development of cellular technologies for growing cell cultures of higher plants – producers of therapeutic substances in bioreactors
• development of techniques for 3D cell cultivation, to grow tissues and organs for subsequent transplantation
• obtaining genetically modified plant cell cultures to develop technologies for making new drugs
• reproductive medicine, including sex cells biology
• regenerative biology and medicine; cell and molecular mechanisms for regeneration of body structures and functions
• molecular, genetic, metabolic and protein engineering
• research to establish interconnection between biomolecules’ structure and functions; functional bio-structures engineering, based on the above data (about interconnection between biomolecules’ structure and functions)
• development of highly efficient techniques for separation and refining of vaccines, antibodies, ferments, medicinal proteins, including with the help of affine chromatography
• development of genetic engineering methodology and in vivo bioengineering, based on integration of symbiotic microorganisms’ and plants’ genetic structures
• design of endosymbiotic microbe-plant systems with extended biosynthetic, production and adaptive potential
• development of techniques and devices for delivering drugs to target organs and cells
• creation of transgenic plants, animals, insects, microorganisms and other live objects – producers of medical, agricultural and industrial products, with the help of genetic and metabolic engineering; development of technologies to make and use them
• development of techniques for identification of genetically modified organisms
• development of preparations with immunomodulation, anti-tumour and other vital biological activities, based on natural biopolymers; development of drugs and diagnostics based on such preparations
• creating therapeutic antibodies and their fragments, based on protein design; immunoglobulin libraries on display (phage, bacterial, yeasty)
• creating therapeutic preparations based on mimetic antibodies
• creating recombinant therapeutic anti-tumour vaccines based on immuno-adjuvant proteins
• creating biotechnological sensors based on genetically adjusted cells, to detect low concentration of substances and for diagnostic purposes
• inhibition techniques to stop progressive growth of tumours; development of targeted drugs, including those to prevent metastasis
• combined treatment technologies, combining chemical, bio-therapeutic and physical impact (radiation, ultrasound, laser etc.)
• rehabilitation technologies for people who suffered heart attacks or strokes, including new drugs for brain and heart cytoprotection in critical states (ischemia-reperfusion etc.)
• technologies and equipment for low- and non-invasive diagnostics, including medical imaging, automated equipment for clinical and biochemical tests, personalised medical equipment (glycometers etc.)
• development of low-allergic contrast preparations for visual diagnostic techniques (ultrasonic scanning, angiography, computer tomography, magnetic resonance scanning)
• development of testing systems for quick diagnostics of malignant neoplasms, HIV, hepatitis, sexually transmitted infections, feral herd infections, pandemic infections
• further development of ECG techniques, making them available to all patients (including ECG screening of babies)
• Technologies for making efficient vaccines to prevent and cure oncological diseases

The level of Russian R&D in Efficient Nature Management category is not particularly high. This area includes three critical technologies. The biggest advances have been made regarding technologies for preventing and cleaning up environment pollution, monitoring the state of environment and forecasting its development.

1. Technologies for preventing and cleaning up environment pollution, monitoring the state of environment and forecasting its development

Good progress has been made regarding national-level monitoring of greenhouse gases emissions; monitoring gaseous and aerosol composition of the atmosphere; monitoring greenhouse gases emissions at mobile train-mounted laboratories; monitoring biological productivity of water-based ecosystems.

On the other hand, R&D in the area of long- and medium-term forecasting of greenhouse gases emission levels; estimation of natural and anthropogenic emissions of greenhouse gases, chemically active and toxic substances; development of advanced equipment for geophysical studies of wells; and advanced equipment for monitoring water-based ecosystems (reservoirs and flows) lag behind the top world level.

2. Technologies for preventing natural and anthropogenic disasters and dealing with their consequences

The most advanced R&D results – on a par with the best world-level achievements – regarding this technology include techniques for medium-term forecasting of major earthquakes, based on a set of prognostic indications (Map of Expected Earthquakes Algorithm, M8) whose efficiency has been tested in various seismically active areas of the world for the last 20 years; techniques for assessing pollutant emissions (including accident-related ones) from transport, industrial facilities, utility installations etc.

Regarding development of sensor components for monitoring systems, increasing the number of Russian stress axes locally reconstructed on the basis of instrumental data and nature-state indicators, and creation of national system of air quality and pollutant emissions monitoring (including land- and space-based stations, data centres, calibrating and validation centres), Russia lags behind the world leaders.

3. Technologies for searching, prospecting, mining and processing natural resources
The most advanced R&D results in this area, on a par with or above the top world level, include biotechnologies for increasing extraction of oil from oilfields (terrigenous reservoirs, light crudes, moderate temperatures); vat bi-geo-technologies for extracting gold from hard arsenic-containing pyrite-arsenopyrite ores and concentrates; and microbiological technology for increasing oil recovery for terrigenous reservoirs.

R&D results below the top world level were noted in such areas as environmentally safe and economically viable technologies for increasing oil recovery from heavy oil reservoirs; power-saving technologies for ore disintegration and subsequent enrichment; thinly impregnated ferrous and non-ferrous metal ores.

Most promising areas for Russian R&D in the Efficient Nature Management category include the following:

- contact and specialised distant observations
- technologies for water treatment and water supply; treatment and processing of communal and industrial sewage, drainage etc.
- technologies for treatment of waste gases at industrial and power generation facilities, communal and household power generation installations, vehicles’ exhaust, mobile power generators
- development of universal mathematical model simulating dynamics of atmosphere, ocean, ground waters, cryosphere, basic (affecting the climate) processes in biosphere – to forecast climate change and the state of environment
- technologies for 4D data processing; development of hydrodynamic models of atmosphere and hydrosphere; development of techniques for processing simulation results, including object-oriented models
- techniques for assessing and technologies for using water, climate, soil and biological resources to increase efficiency of management decisions
- technologies for recovery of damaged soil, landscapes and biodiversity
- monitoring of tension on the basis of nature indicators in upper horizons of the Earth’s crust in densely populated areas, locations of complex installations, and high technological activity areas
- establishment of monitoring and control centres, development of various specialised equipment for rescue missions and dealing with consequences of emergencies
- development of efficient response scenarios; ensuring buildings’ earthquake stability and resistance to impact in various emergency situations
- techniques for forecasting natural and anthropogenic disasters and their consequences, based on monitoring data and advanced knowledge of processes leading to their occurrence
- techniques for remote monitoring from satellite systems and space stations
- technologies and equipment for extraction of liquid and gaseous hydrocarbons form hard-to-mine fields and sites, including gas-hydrate accumulations
- technologies for oil and gas transportation by ships and via pipelines
- technologies for production of alternative hydrocarbons including shaft methane; development of technologies for associated gas production
- development of advanced methodology and techniques for geological search and prospecting, to ensure extension of Russia’s resource base
- selective disintegration processes
- technologies for increasing extraction of liquid hydrocarbons from oil-gas condensate field

The level of Russian R&D in Transport and Aerospace Systems category is average; this area includes three critical technologies:

1. Global security technologies based on common transport and information space
The most advanced R&D results in this field – on a par with or above the top world level – include transport safety systems; techniques for safety analysis (a posteriori, a priori and combined); techniques for identification of dangerous and destabilising factors; adaptive centralised detection systems for rolling stock and damaged rails.

R&D in the area of developing techniques for assessing durability and reliability of buildings and constructions, and space-based systems for remote scanning of Earth, lag behind the world leaders.

2. Technologies for making high-speed vehicles and intelligent control systems for new types of transport

There are significant advances in certain aspects of this critical technology, with Russian R&D results being on a par with or above the world leaders’ achievements. In particular, these include development of compact navigation systems for mobile objects; all-purpose intelligent onboard control systems for autonomous mobile objects; and control systems based on associative memory.

On the other hand, there’s serious lagging behind in the area of automating information and management processes; control and management systems; data visualisation for combined and virtual-reality applications.

3. Technologies for making power-efficient, environmentally friendly new-generation transport vehicles and systems

Advanced Russian R&D results in this area include liquid-propellant rocket engines; hybrid drive vehicles; vehicles with high and super-high cross-country ability for operation in extreme environments (including low-pressure tires); and four-wheel drive “intelligent transmission” vehicles.

The most significant lagging behind is noted in engine diagnostics and emergency protection systems; power transmission systems for high-speed engines; and space-based systems for remote scanning of Earth.

Based on the above analysis, the following most promising areas for Russian R&D in this field could be identified:

- technology for creating automated management system covering all transport modes
- technology for creating automated transport information system (including planning and management information subsystem and traffic participants information subsystem)
- technology for creating automated safety system, including the following subsystems: operational management of special-purpose vehicles (emergency response, police, ambulance); traffic accidents response; video monitoring of transport infrastructure and traffic flows; detection of traffic violations
- technologies for making environmentally neutral engines
- technologies for making liquid-propellant rocket engine
- technologies for making carrier rockets and accelerating units;
- techniques for calculation and design of railway rolling stock
- techniques and technologies for making engines and vehicles working on alternative fuels and energy sources
- technologies for making hybrid drive vehicles
technologies for making fuel cells to power vehicles

The level of Russian R&D in **Power Efficiency and Power Saving** category is quite high, primarily thanks to nuclear power technologies. This area includes four critical technologies:

1. Nuclear power technologies, nuclear fuel cycle, safe treatment of radioactive waste and depleted nuclear fuel

   Nuclear industry’s S&T complex remains globally competitive and ensures that Russian nuclear technologies retain leading positions in many areas and fields. Basic research is underway regarding safety of nuclear power plants’ reactors, and work on building ITER international nuclear reactor. Russia is the leader in such areas as nuclear fuel breeding fast reactors; closed fuel cycle for uranium, plutonium, minor actinoids; nuclear thermal power plants based on modular multipurpose fast reactor SVBR 75/100 with lead-bismuth heat-transfer agent; small and medium-capacity nuclear power plants; and many more.

2. New and sustainable power sources technologies, including hydrogen-based power generation

   The most advanced R&D results in this area include highly efficient thermoelectric materials based on silicon compounds; solar photo-power plants based on heterostructured cascade photo-transformers and beamformers; cascade radiation-resistant photo-transformers for space solar batteries; water electrolysis systems.

   The least developed R&D areas include small-scale wind-power engineering and thermoelectric materials based on nanostructures.

3. Technologies for making efficient power transmission, distribution and consumption systems

   The level of Russian R&D in this area, particularly regarding highly efficient light sources and polymer-based radiation modified compositions is on a par with the world leaders. There are promising advances in the field of controlled power transmission equipment including devices for protecting grids from earth faults and making objects of various height safe from lightning strikes.

   Efficient technologies for making synthetic liquid fuel are among the least developed in Russia, far behind the top world level. Other lag-behind areas include superconducting magnetic storage systems, for use at production, storage and flow control facilities.

4. Technologies for efficient production and conversion of power based on organic fuel

   R&D in this area are on a par with the world leaders. In particular regarding combined steam-gas cycle with high-temperature combustion chamber for burning hydrogen in oxygen, with subsequent mixing of high-temperature and low-temperature steam. Good progress has been made in developing power generators based on high-temperature steam turbines.

   The most lag-behind areas include powerful gas-turbine installations with initial gas temperature of 1,350-1,700 degrees Celsius, and fluorocarbon-based power plants.
The most promising areas for Russian R&D in the Power Efficiency and Power Saving category include:

- technologies for making nuclear fuel
- new-generation nuclear power plants’ power-generating units
- small-capacity nuclear power generators
- further improvement of fuel cycle
- technologies for making hydropower generators, including those designed to work on small rivers
- technologies for making modular geothermal power plants
- technologies for making thermochemical gas generators to process solid organic waste
- technologies for transforming solar radiation into power
- technologies for long-distance power transmission
- technologies and equipment based on low- and high-temperature superconductivity
- instrumentation and computing equipment for efficient operation of power plants
- technologies for making steam-gas plants based on natural gas, liquid or solid fuel
- technologies for making devices and systems with reduced environmental pressure
- technologies for making integrated power unit automated management systems

4. Comparison of future thematic S&T priorities between the EU and Russia

In the framework of the ERA.Net RUS project ([http://www.eranet-rus.eu/](http://www.eranet-rus.eu/)), a targeted foresight exercise is aiming at identifying and elaborating future core arenas of S&T and innovation cooperation between the EU and Russia. Scenarios are going to be developed to explore sustainable mid-term cooperation in S&T and innovation between the EU MS/AC and Russia.

This review serves as a basis for the comparison of future thematic S&T priorities between the EU and Russia. In the following words cloud on the future EU thematic S&T priorities greater prominence is given to (the highlighted) words that appear more frequently in the previous sections.

Figure on the future EU thematic S&T priorities [created with [http://www.wordle.net/](http://www.wordle.net/) on 20/04/2011]

In the following words cloud on the future Russian thematic S&T priorities greater prominence is given to (the highlighted) words that appear more frequently in the previous sections.
The creation of permanent joint European Commission – Russia research working groups, under the Science and Technology Cooperation Agreement, in essentially all the thematic priorities of the FP, has been a substantial step towards more common research agendas and an increasingly common decision-shaping processes between the EU and Russia. One of the outcomes of the discussions in many of these thematic groups has been the establishment of a number of coordinated calls. Until end 2010, six such calls have taken place in key thematic areas: health research, biotechnology, nuclear fission, nanotechnology, aeronautics and air transport and energy research. Further coordinated calls with Russia in health, high performance computing and in nanotechnology are currently being implemented.

By cross-checking the EU thematic S&T priorities with the national priorities of the neighbouring country, in our case the Russian Federation, the common denominators can be identified:

The comparison of the word clouds confirms that the EU-RF Scientific and Technological Cooperation Roadmap is on the right track especially with S&T programmes in the fields of energy, transport, health, nanotechnology. Besides, it is worth mentioning that both reviews revealed that a strong focus lies on the technological implementation (including biotechnology). While the EU emphasizes thematic fields supporting a sustainable development, i.e. food, water and energy security, climate change, the Russian Federation calls apart from the similar topics environment, life systems and nature management also for information and telecommunication systems. Socio-economic areas and humanities are clearly underrepresented apart from ageing and population in the EU.

The outcomes of this study will support the identification of future common S&T and innovation fields of mutual interest for cooperation programmes between the EU and neighbouring countries, and thus the internationalization of the ERA, which in a second phase shall be validated through expert surveys and workshops. The priority-setting and foresight exercises shall therefore provide later on policy options for establishing sustainable R&D and innovation cooperation programmes between the EU and European
Neighbourhood Countries through the definition of common research agendas and respective allocation of funding.

5. References


8.5 Annex 5: Thematic roadmaps by thematic areas

8.5.1 SSH

SSH Roadmap – Societal challenge "Inclusive, innovative and secure societies"
8.5.2 Health

- Societal Challenges
  - Understanding the determinants of health, improving health promotion and disease prevention
  - Developing effective screening programmes and improving the management of disease susceptibility
  - Improving surveillance and preparedness
  - Understanding disease
  - Developing better preventive vaccines
  - Improving diagnosis
  - Using in-silico methods for improving disease management and prediction
  - Rethinking disease
  - Transforming knowledge to clinical practice and scalable innovation actions
  - Better use of health data
  - Improving scientific tools and methods to support policy making and regulatory needs
  - Active ageing, independent and healthy living
  - Individual empowerment for self-management of health
  - Promoting integrated care
  - Optimising the efficiency and effectiveness of healthcare systems and reducing inequalities through evidence-based decision making and dissemination of best practice, and innovative technologies and approaches.
  - Specific implementation aspects: (from knowledge to technology transfer to large-scale demonstration actions, leading to scalable solutions)

- Market
  - Regenerative medicine
  - Biodegradable materials

- Key technologies
  - Diagnostic
  - Implants
  - Surgical technique
  - Targeted drug delivery

- Research areas
  - Molecular diagnostics
  - Biomedical cellular technology
  - Nanomaterials and nanotechnology
  - Tissue engineering
  - New generation of bioprinters
8.5.3 Nanotechnology

Roadmap “Nanotechnologies”

Nanotechnology challenges:
- Grand challenges:
  - Ageing and demography
  - Behavioural change & privacy
  - Economic dynamics
  - Education dynamics
  - Disease and health
  - Crime and terrorism
  - Ethics and abuse of S&T
  - Food safety and diet
  - Governance and democracy
  - Social pathologies and addictions
  - Social exclusion and poverty
  - Social cohesion and diversity
  - Work-life balance
  - Energy dynamics
  - Innovation dynamics
  - Globalisation vs. localisation
  - Coexistence and conflicts
  - Urban and rural dynamics
  - Techno-security & risks
  - Sustainability (climate change)
  - Water security

Nanotechnology applications:
- Nanospecific challenges:
  1. Increased demand for new materials to manufacture products with radically reduced and adjustable properties
  2. Development of new materials with improved stability
  3. New material and use characteristics of various parts and infrastructure materials

Premiering product groups:
- For industrial use:
  - Gas sensors
  - High-strength composite polymeric nanomaterials
  - Durable composite polymeric nanomaterials
  - Durable nanocoatings
  - Antiviral polymeric nanocoatings
  - Water-resistant and high-temperature composite polymeric nanomaterials and nanocoatings

- For end-users:
  - Nanodetectors to increase crop capacity
  - Oil and gas production and processing
  - Catalysts for chemical, petroleum and power industries
  - Nanodevices to make energy sources (including fuel cells), and for high-energy densities
  - Solar cells

Research areas:
- Construction materials
- Functional materials
- Hybrid materials, convergent technologies, bio-nanomimetic materials, medical materials, computer modelling of materials and processes
- Diagnostics of materials
- Social aspects
- Nanoscale and surface technologies
- Nanomaterials for conservation and treatment of physiological and other biological systems
- Sensing and sensors for medical diagnostics
- Nanosensorics equipment
- Water-renewal and purification systems
8.5.4 Environment/Climate Change

Environment & Climate Change Roadmap

Societal Challenges: CLIMATE, RESOURCES AND RAW MATERIALS
- Fighting and adapting to climate change
- Sustainably managing natural resources and ecosystems
- Ensuring the sustainable supply of non-energy and non-agricultural raw materials
- Enabling the transition towards a green economy through eco-innovation
- Developing comprehensive and sustained global environmental observation and information systems

Societal Challenges: ENERGY
- Reducing energy consumption and carbon footprint through smart and sustainable usage
- Low-cost, low-carbon electricity supply
- Alternative fuels and mobile energy sources
- A single, smart electricity grid
- Robust decision making and public engagement
- Market uptake of energy innovation, empowering markets and consumers

Subchallenges: CLIMATE, RESOURCES AND RAW MATERIALS
- Improve the understanding of climate change and the provision of reliable climate projections
- Assess impacts, vulnerabilities and develop innovative cost-effective adaptation and risk prevention measures
- Support mitigation policies
- Further our understanding of the functioning of ecosystems, their interactions with social systems and their role in sustaining the economy and human well-being
- Provide knowledge and tools for effective decision making and public engagement
- Improve the knowledge base on the availability of raw materials
- Promote the sustainable supply and use of raw materials, covering exploration, extraction, processing, recycling and recovery
- Find alternatives for critical raw materials
- Improve societal awareness and skills on raw materials
- Strengthen eco-innovative technologies, processes, services and products and boost their market uptake
- Support innovative policies and societal changes
- Measure and assess progress towards a green economy
- Foster resource efficiency through digital systems

Research Areas
- Environmental protection and safety technologies
- Climate change, including regional and extreme climatic events
- Atmospheric circulation systems, including basic climate modes, non-tropical and tropical cyclones
- Cryosphere dynamics, including permafrost and glaciers
- Transfer and transformation of environmental pollutants, including micro- and nanoparticles
- Changes in the environmental state of landscapes, land forms, erosion and channel processes, bio-geochemical flows, biodiversity
- Impact of natural and anthropogenic factors on people’s health and activities under changing climate and environment
- Environment management systems for cities, territorial planning
- Technologies for monitoring the state of the environment
- State and dynamics of water and land ecosystems, their resources, and recovery of resource potential of the areas experiencing high anthropogenic pressure (soils, biological and water resources)
- Monitoring environmental effects of climate change, including processes in permafrost areas
- Monitoring of pollutant emissions/dumping into the atmosphere, water bodies and soils
- Technologies for increasing safety of potentially hazardous industrial and power-generating facilities (e.g., chemical and nuclear plants, etc)
- Early detection and forecasting of natural and technogenic emergencies

Subchallenges: ENERGY
- Bring to mass market technologies and services for a smart and efficient energy use
- Unlock the potential of efficient and renewable heating/cooling systems
- Foster smart cities and communities
- Develop the full potential of wind energy
- Develop efficient, reliable and cost-competitive solar energy systems
- Develop competitive and environmentally safe technologies for CO2 capture, transport and storage
- Develop geothermal, hydro, marine and other renewable energy options
- Make bio-energy competitive and sustainable
- Reducing time to market for hydrogen and fuel cells technologies
- New alternative fuels

Technologies and systems for mineral prospecting and integrated development of mineral and hydrocarbon resources
- Research on the industrial use of wastes from mining and raw materials processing
- Prospecting-related research: new mining areas, geophysical techniques for oil and gas prospecting under unconventional geological conditions
- Identification and utilisation of non-conventional raw materials sources, including hydrocarbons, such as heavy crudes, gas-hydrates, shale gas
- Inventory and utilisation of resources of the World Ocean, Arctic and Antarctic regions
- Earth remote sensing technologies, including for environmental monitoring and resource evaluation
- Environmentally safe marine prospecting and mining of various mineral resources under the extreme oceans, Arctic and Antarctic environments
8.6 Annex 6: Results of the ERA.Net RUS Thematic Roadmapping Workshops

8.6.1 Consensus ERA.Net RUS SSH workshop, Brussels 22 April 2013

SSH topics for the ERA.Net RUS Plus call:
1. Understanding Conflict, Identity, and Memory: Past and Present
2. Demographic Change, Migration and Migrants
3. Opportunities for and Challenges to Regional Development and Social Cohesion

Short topic drafts

Topic 1: Understanding Conflict, Identity, and Memory: Past and Present
The EU countries, several countries associated to the EU’s FP7 (e.g. Turkey, Moldova) and Russia share a long history of war and peace. The just passed 20th century was coined by two World Wars and the following Cold War between two ideological systems, dividing the world in “the West” or NATO members and “the East” or Warsaw Pact states. This historical, societal, mental and cultural heritage did not only shape the world we are living in today, but also provides the foundation for political institutions like the EU, for partnerships and economic cooperation between states, for misunderstandings and new conflicts to be avoided. Thus the knowledge about the roots of the construction and formation of the world today may help to understand the origins of conflicts, the varieties of identities and the different memories of people we have to deal with today.
The main goal of this research theme is to conduct research on conflict, identity and memory in Europe and beyond, providing knowledge about the multilayered political, social, economic and cultural formations of the 21st century’s world. Such topics as a multi-paradigmatic understanding of war and peace, violence, ethnic conflicts, identity, dissent and consensus, multiculturalism, globalization, regionalization, integration, cultural heritage, archives, collective memory, national and international security will be the key areas of research and innovation.

Topic 2: Demographic Change, Migration and Migrants
Growing migration in the EU and Russia entails both serious positive and negative social and political consequences. Migration is a source of development, economic growth, and at the same time it may deteriorate social health and threaten with change of cultural identity. Negative consequences of migration are connected with socio-political destabilization. Multiculturalism is loosing its role of the ideology for migrants’ integration. Under these circumstances the EU and Russia are interested in a scientific substantiation of the real and seeming benefits and threats relating to migration. To this end, it is necessary to elaborate new conceptual models for inclusion of migrants into the society, as well as methods for measuring social consequences of migration.

Topic 3: Opportunities for and Challenges to Regional Development and Social Cohesion
Research proposals under this theme will include comparative, multiple-methodology-using, boundary spanning (academia-policy-practice) studies on the nature and impacts of economic, political, social and/or environmental developments on sub-national level. Research may look at urban and rural issues, as well as make use of the notions of city-region and other hybrid
spaces. Key topics where joint research may be of particular benefit would include the
development challenges and solutions in sparsely populated areas (e.g. strategies against
poverty and for sustainable local development, including social services, networks of
enterprises, social innovation); the changing patterns of land use and their impact on
sustainability and local production systems (e.g. the presence of industrial companies in
agricultural and primary production, impact on market chains and local food systems);
agency, community initiatives, and associations for local development; different forms of
civil society and governance systems and their interrelation on local level; research and
business links for regional development, avenues for multi-stakeholder collaboration, new
economic forms, and organisational innovation. Social cohesion is inherent and linked to any
of the above mentioned themes and it concerns exploring the sharing of values, sense of
belonging, civic participation, trust, justice, equality and others.

Additional /Perspective Topics

4. Understanding conflict and security issues

The EU countries, several countries associated to the EU’s FP7 (e.g. Turkey, Moldova) and
Russia share a long history of war and peace. The geographic proximity, geopolitics,
competition and cooperation for the global markets are issues that need to be addressed with
priority. However, the whole plethora of initiatives and partnerships or generous strategic
goals cannot be completed without a common understanding of the roots of cultural,
historical, ethnic or ideological conflicts, and a construction of a common vision, based on
research and innovation.
The main goal of this research theme would be to develop a common framework for research
of conflicts and security issues, leading to the accomplishment of the Horizon 2020 strategic
goals in tackling global societal challenges together with international partners of the EU.
Such topics as multi-paradigmatic understanding of war and peace, violence, ethnic conflicts,
globalization, regionalization, integration, national and international security will be the key
areas of research and innovation.

5. The relevance of archives for SSH research

Archives store an important part of the history of mankind. But there are various challenges to
the archival situation today: first, state archives, especially in former authoritarian or
dictatorial systems, did only collect documents from official institutions and representatives
of the state and its organisations, while those persons or groups who acted in opposition to the
regime had barely a chance to store their material at a safe place. This material is today
scattered over a variety of academic institutions or NGO archives. Second, all archives are
still on paper and thus threatened to decompose and be lost after some decades. Third, history
and culture today are increasingly researched and narrated in European or global terms what
makes it more and more important for researchers to have the material available online.
Fourth, due to a variety of circumstances a lot of personal files or other collections are
scattered over different archives, often in different countries. So there is a growing need for
digitalization and uniting archival holdings in a virtual archive on the internet. EUROPEANA
is one measure to establish a central, all available data base of European heritage. But
important collections are not restrained by national borders. Especially today, at the beginning
of the 21\textsuperscript{st} century, 20 years after the end of the Cold War, it is important to conduct research
on the development of both sides of the “Iron Curtain” before and after it fell. There are some
pioneering national projects of editing, mostly in books, sometimes online, the shared history
and cultural heritage which is still divided over different countries. But it is a task of real
European scale to unite these holdings and provide the funding for a) providing information
on the respective holdings, b) uniting them in a virtual archive c) and thus enabling research on the shared history of the political, economic and cultural formations of today.

ERA.Net RUS Thematic Workshop SSH – Voting of topics

RESEARCH AREAS

<table>
<thead>
<tr>
<th>Research Areas</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical / cultural research to understand conflict/coalitions/ identity/ integration</td>
<td>5</td>
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<tr>
<td>Cultural heritage</td>
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<tr>
<td>Archives</td>
<td>1</td>
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<tr>
<td>Historical transformation in transport</td>
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<tr>
<td>Development of the creative (digital) content &amp; activities connected to the Archives and Museums</td>
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<tr>
<td>Understand global migration flows , and their forecasts until 2050</td>
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<tr>
<td>Cultural interactions and multiculturalism</td>
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<td>Interactions between ethnic and religious groups</td>
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<td>Models of group relations, diagnosis of group conflicts</td>
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<td>Social groups - youth culture</td>
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<tr>
<td>Regional territorial and social cohesion</td>
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<tr>
<td>Sustainable development models for regions and cities, taking into account infrastructural and intuitional limitations</td>
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<tr>
<td>Understanding spatial economic patterns and behavior</td>
<td>2</td>
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<tr>
<td>New regional trends, separatism and conflicts</td>
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<td>Study world regions</td>
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<td>Models for the organization of the R&amp;D sector &amp; of innovation systems</td>
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<tr>
<td>Public understanding of science</td>
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<tr>
<td>Knowledge creation, structuring, transmission, usage</td>
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<tr>
<td>Institutionalisation of knowledge economy and knowledge transfer</td>
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<td>Prospective studies</td>
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<tr>
<td>Models &amp; indicators</td>
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<tr>
<td>Intellectual capital measurement and reporting</td>
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<tr>
<td>Models of social partnerships and civil society institutes</td>
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<tr>
<td>Study democracy, rule of law poverty, social security, market and global responsibilities</td>
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<td>Participations and citizenship</td>
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<td>Citizen education</td>
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<tr>
<td>Developing new sectors of economy</td>
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<tr>
<td>Public policy administration</td>
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<tr>
<td>Multilinguistic society</td>
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<td>Multilingual communication, language learning, interpreting, translation</td>
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<tr>
<td>Environmental values</td>
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<tr>
<td>Economic and psychological aspects of social behavior changes - experimental approaches in social sciences</td>
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## CHALLENGES

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Points</th>
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<tbody>
<tr>
<td>Understand cultural issues</td>
<td>5</td>
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<tr>
<td>New states, new identities, new values, new territories. Challenges: identities in the rapidly changing environment, changing values, orientation in globalized world.</td>
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<tr>
<td>EU’s/Russia’s heritage, memory, identity, cultural interaction, integration, translation</td>
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<td>Social memory of the past &amp; impacts on social interactions</td>
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<td>Identity, family structures, media etc.) &amp; culture in transition processes</td>
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<td>The past conflict resolution memories</td>
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<td>Support the a culture that changes behavior</td>
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<td>Understanding the demographic change / Demographic change and migration</td>
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<td>Social transformations in European societies</td>
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<td>Understand how threats to security emerge and disappear</td>
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<tr>
<td>New mechanism of economic activities</td>
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<td>Support to policies empowering rural areas and societies / land use and ownership, rural development. Rural societies, fading rural urban borders</td>
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<td>Local societies/ local life/ community development</td>
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<td>Social innovation &amp; creativity / employment policies / social aspects of technology / social impacts</td>
<td>3</td>
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<td>Position of EU/Russia as global actor</td>
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<tr>
<td>Well being</td>
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8.6.2 Consensus ERA.Net RUS Health workshop, Brussels 23 April 2013

Health topics for the ERA.Net RUS Plus call:
1. Molecular Mechanisms of Brain Function and Pathology
2. Regenerative Medicine and Biomaterials
3. Drug Discovery for Cancer, Cardiovascular and Infectious Diseases

Short topic drafts

Topic 1: Molecular Mechanisms of Brain Function and Pathology
Brain research is focused on investigation of brain function in normal and pathological stay of
the organism. It may comprise functional imaging of different brain zones, elaboration of new
approaches how to investigate cognitive functionality and stimulate signaling processes. The
animal models of mental, neurodegenerative and neuronal inflammation may be regarded
here. Application of these data for human are stimulated. Stroke and post-traumatic effects,
epilepsy research are appreciated. New approaches to drug discovery and delivery in brain
neuronal diseases including primary carcinogenesis and metastasis are welcomed.

Topic 2: Regenerative Medicine and Biomaterials
Regenerative medicine remains one of the great challenges of clinical practice. Many of the
world’s leading pathological processes, including cardiovascular diseases, cancer, diabetes,
and traumatic injuries, could be alleviated by regenerative medicine. For example, new
methods for pancreatic endocrine cells regeneration can be used to treat diabetes, tissue
engineering therapy can help in coronary artery disease, and novel nervous tissue regeneration
technologies can be utilized in stroke treatment. Effective biomaterials for tissue regeneration
will, therefore, find applications in practically every clinical discipline. Regenerative
medicine has the potential to improve patient outcomes, lower the incidence of complications,
and reduce hospital stays. Such technologies will enable cost-effective treatments, and lessen
morbidity and mortality.

Topic 3: Drug Discovery for Cancer, Cardiovascular and Infectious Diseases
Top causes of mortality (excluding incidents) worldwide are cardiovascular diseases, cancer
and infectious diseases. The need for new principally novel drugs for treatment of these
diseases is hard to overestimate. The main efforts should be invested into identification and
study of drug targets, rational design and high throughput screening of potential drug
candidates (leads). In this area there are many possibilities for successful scientific
collaboration between EU and Russia.

The understanding of specific molecular mechanisms/pathways underlying particular disease
initiation and progression, treatment resistance, etc. offers possibilities to identify relevant
biomarkers, promising targets for new drug development. The evaluation and validation of
such biomarkers using the state-of-the-art technologies, the development of relevant
experimental scientific models, and the collaboration with biobank teams will be encouraged.

Additional /Perspective Topics
4. Translational Medicine

Translational medicine is the process of the bidirectional transfer of knowledge
between basic work (in the laboratory and elsewhere) with that of the person, in health or
disease. Translational research is the basis for translational medicine. It is the process which
leads from evidence based medicine to sustainable solutions for public health problems. There
are three phases. Phase 1 is the research process that investigates and translates non-clinical
research results into clinical applications and tests their safety and efficacy. This is often called "bench to bedside". Phase 2 examines how findings from clinical science, shown to be efficacious and safe treatments established in phase 1 translational research, function when they are applied in routine practice. In this phase, studies of health economics adds the evaluation of cost effectiveness and cost avoidance. Phase 3 Translational Research adds the necessary information to convert treatments and prevention strategies into sustainable, evidence-based practices and policies.

For the rapid translation of scientific data into clinical practice, it is necessary to develop new standards with the use of innovation, with the collaboration of great importance.

There are many difficulties in the development of translational medicine, at the example pharmacogenetic. Advances in the field of pharmacogenetics - the study of the genetic differences that influence how we metabolise and respond to medicines - have led to diagnostic tests that have been slow to gain widespread use, despite clear advantages. This is due to insufficient translational research and a lack of awareness of clinicians and the public. Genetic tests have mostly been done for rare diseases in clinical genetic centres and this also induces the belief that the test would be costly but a pharmacogenetic test can be ten times cheaper than a genetic test for a rare congenital disorder. It also has large economic benefits DNA test can identify patients who, for example, require 10 to 50 percent of the standard dose of a particular drug to avoid severe side effects.

It is necessary to establish centers of translational medicine, which will coordinate the transfer of technology and interact with clinics and hospitals on one side and with the institutions on the other. Support for translational research is necessary for optimal development of the modern hospital.

5. 3D Medicine, Virtual Surgery

This topic concerns development of new tools, methods and algorithms for visualisation of biological processes on cell-tissue level – 3D modelling of ribosome, spatial and compartmental affinity and specificity of metabolism. Modelling of infectious diseases on microscopic level (phylogenetic analysis, visualisation of function-structure), and macro level – control of existing and emerging epidemics.


Artificial intelligence in medicine: machine supported learning, interpretation and decision support systems based on novel detection, visualisation, multimodal analytical methods; novel approaches to monitoring and control of organ systems and whole virtual physiological human prototypes.
### Challenge – SC 2

<table>
<thead>
<tr>
<th>Topics</th>
<th>Votes</th>
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<tr>
<td>basic research - understanding molecular mechanism/Basic Neural Sciences/Understanding brain</td>
<td>11</td>
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<tr>
<td>Regenerative medicine/biomaterials</td>
<td>8</td>
</tr>
<tr>
<td>Diagnostic tools/Biomarkers dev./strategic import/ molecular diagnosis and human proteome profiling /replace pre-clinical studies &amp; trials</td>
<td>7</td>
</tr>
<tr>
<td>Understanding disease: understanding determinants of health</td>
<td>6</td>
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<tr>
<td>Infectious Diseases/pandemics/virological disease</td>
<td>3</td>
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<tr>
<td>Active ageing, independent &amp; assisted living: technology development (robotics, architecture, etc.)</td>
<td>3</td>
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<tr>
<td>Personalised data, increase cohorts</td>
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<td>affordability of expensive treatment / economy of drugs (cost of drugs) /ethics</td>
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<tr>
<td>Prevention: early diagnosis (CT, Markers)</td>
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<tr>
<td>health style/primary prevention/ public health /develop better preventive vaccines /individual empowerment for self-management of health</td>
<td></td>
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<tr>
<td>Biodegradable &amp; composite medical material</td>
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### Research topics having emerged from discussion – flip chart

<table>
<thead>
<tr>
<th>Topics</th>
<th>Votes</th>
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<tbody>
<tr>
<td>Drug discovery &amp; development</td>
<td>7</td>
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<tr>
<td>Translational research</td>
<td>5</td>
</tr>
<tr>
<td>antibiotics, 3D structure, ribosome, in-silico/ infectious diseases treatment, mathematical modeling</td>
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<tr>
<td>Man on the chip/preclinical trials/replace preclinical by cell studies (high throughput research e.g. immunology, bioreactors)</td>
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<td>Antibody treatment</td>
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<td>Telemedicine, centralisation of health care, social dimension</td>
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<td>pathology based approach</td>
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<td>models of public health organisation</td>
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<tr>
<td>drug delivery system</td>
<td>1</td>
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<tr>
<td>Joint datasets, public health data, integrating data, legal barriers, regulation, patient consent, ethical issues, data use and ownership</td>
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<tr>
<td>manufacturing technologies on industrial scale</td>
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<tr>
<td>3D medicine, virtual surgical technologies</td>
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<tr>
<td>improve scientific tools for policy: therapy, improve acceptance of drugs; review of drug effectiveness, ECDC</td>
<td></td>
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</tbody>
</table>
8.6.3 Consensus ERA.Net RUS Nanotechnology workshop, Moscow 16 May 2013

Nanotechnology topics for the ERA.Net RUS Plus call:
1. Advanced nano-sensors for Environment and Health
2. Novel functional nanomaterials based on design and modelling
3. Nanomaterials for efficient lighting

Short topic drafts

Topic 1: Advanced nano-sensors for Environment and Health
Recent progress and advancements in the synthesis of nano-scale materials and coatings have paved the way for the development of innovative and high-performance sensor architectures. The desired properties of such nano-sensor devices include ease of fabrication and integration, compactness, high sensitivity, short response time, reliability and re-usability. In order to achieve the maximum sensor performance, sensing mechanisms (optical, chemical, electrical, mechanical, magnetic, etc.) should be understood clearly. Besides nano-scale materials synthesis, sensor design, sensor fabrication process and recipe development, sensor performance testing is as critical as well for optimum device performance. Environment and health are two major fields in which sensor technologies are heavily used. The aim of this topic is to pursue research and development (R&D) activities between European and Russian research institutions to promote a strong cooperative interaction, based on KET - Key enabling technologies (nanotechnologies, ICT, advanced materials, etc.) and on the use of top-down and/or bottom-up micro/nano-fabrication processes for advanced and innovative nano-scale sensor structures primarily for environmental and health applications. Sensing mechanisms to be explored might include but are not limited to optical, electrical, chemical, mechanical, and magnetic detection.

Topic 2: Novel functional nanomaterials based on design and modelling
Functional nanomaterials play a key role in modern technologies improving their cost effectiveness and efficiency as well as expanding industrial applicability. However, the development of novel functional nanomaterials must progress from a laboratory-driven ad hoc discovery process to a more systematic engineering approach based on the use of advanced fabrication and characterization tools along with modelling and simulation. The aim of this topic is to pursue research and development (R&D) activities between European and Russian research institutions to promote a strong operative interaction, based on KET - Key enabling technologies (incl., nanotechnologies, ICT, advanced materials, biotechnology, advanced manufacturing and processing) and on the use of micro- and nanofabrication infrastructures, large-scale research facilities (e.g., synchrotrons, nuclear reactors, neutron sources, free electron lasers) and high performance computing. Simulation and modelling became an efficient tool for designing robust and high-performance functionalized nanomaterials. Diverse methods, including quantum-chemical calculations, QSAR/QSPR (Quantitative-Structure-Activity/Property-Relationships) or QNAR as a QSAR option for nanomaterials, data mining, the use of artificial neural networks and genetic approaches, accompanied by high-throughput experimental library tests should be used for elaboration of predictive algorithms aimed at development of the new generations of functionalized nanomaterials. The development of nanomaterials by design should be also complemented by rigid nanotoxicity and nanoecotoxicity metrology tests aimed at directing the progress in production of nanomaterials toward human-friendly and environment-friendly products.
**Topic 3: Nanomaterials for efficient lighting**

In Europe, in the service sector alone, for example, lighting consumes up to a quarter of the total electricity consumption of the sector. Any improvement in the efficiency of lighting devices therefore results in substantial energy savings. It has been asserted now that future energy sustainability will have to be supported by large energy savings and it is therefore the aim of this topic to favour researches in nanomaterials and nanotechnologies that could improve the efficiency of lighting devices. Cost effectiveness induced by the use of new nanomaterials or nanotechnologies in lighting devices that would favour their public use can also be considered.

**Additional /Perspective Topics**

4. **Solar Cells: Nano-photonics for energy conversion**

Better understanding and optimal technological application of nanoscale phenomena are expected to bring the essential support needed for economical, large scale photovoltaics (PV) over the next two decades. Breakthroughs towards higher efficiency, as well as for lowering the costs of production and deployment of solar energy conversion devices are highly needed. In this context, the objective of this topic is to encourage collaborative R&D focused on nanotechnology solutions for improved solar PV, directed towards:

1) **efficiency improvement**
   - e.g., through the use of nanoparticles, quantum dots, various nanostructuring strategies, surface chemistry, thin film optimization, plasmonic effects, nanoscale engineering of organic materials, improvements of device architecture, hybrid organic/inorganic technologies, innovative solutions for electrodes, new materials to harvest a wider range of the solar spectrum, better tools for probing relevant nanoscale phenomena etc.; and/or
2) **reducing costs of materials, production and deployment; higher lifetime**
   - e.g., through replacement of c-Si with cost-effective and abundant alternative materials, inorganic nanoparticles precursors, alternative thin-film technologies, nanostructuring allowing cost reduction by relaxing the purity constraints at the same target performance, reducing the active layer thickness, new nanoscale chemistry, BHJ technologies, nanoengineering of the device architecture, self-assembly strategies, replacement of ITO with alternative materials, solutions for ensuring mechanical flexibility and higher lifetime (e.g., nanostructured barrier coatings) of the device, etc.

5. **Diagnostics: Metrology at the Nanoscale**

The present nanotechnology development stage can be described as Nano1=>Nano2 transition. This means a transition from the situation where the prevailing activities were research and development to the era where prevailing activities will be related to industrialisation. Industrialisation, i.e., mass production of nanoscale structures and materials, requires reproducibility of the product, from day to day, month to month, and at various production scales, depending on the added value of the nano-product. This situation is a considerable challenge for research and industry. The advantages of nanomaterials and nanostructures rely on their shape, size and chemical gradients in the nano-scale. This is the essence of nanotechnology: new properties resulting from size, scale, and complex nanostructures. This situation requires new knowledge to be developed, where the focus is not on producing a new kind of nanostructure, but to ensure uniformity and reproducibility of the already established ones. In addition, norms and regulations are necessary that ensure that the proper nano-scale characteristic is recognised and methods for its evaluation are mutually agreed by all stakeholders: producers, customers, regulatory bodies, NGOs, safety experts. The new metrology methods should best be applied in real time during nano-production.
Thus, research projects would include identification of the key nano-scale parameters important for the product properties, safety, efficiency, and development of high throughput metrology methods for their evaluation. Progress in this field is a key success factor for industrialisation of nanotechnology.

6. Nano-sized catalysts

Development of economically attractive and environmentally friendly processes in the synthesis of organic products that respond to the needs of “green chemistry” is essentially based on the use of catalysts. The reduction of the consumption and use of critical metals, such as noble metals, gold and rare earth metals is a forefront problem of the research communities in the EU, associated countries to FP7 and Russia. Even evolutionary solutions will help to reduce the dependence of these countries on external resources. Most of such critical metals are being used in the composition of diverse families of catalysts (exhaust control, oil and gas processing, fine chemicals production, pharmaceutical manufacture, fuel cells etc). The dramatic reduction or, presumably elimination of the content of noble metals in the catalysts, especially coupled with the extensive application of conventional and cheap transition metals would open new perspectives and would strengthen the competitive position of the economies. Novel efficient and robust catalysts containing no critical metals or a significantly reduced content of noble metals should be developed for the syntheses of valuable organic products. Of particular importance are the non-noble catalysts that may be used for the conversion of waste or cheap raw materials into organic products with a high added value, which falls within the area of big pharma and fine chemicals. The research should unravel fundamental properties of nanoengineered metallic and metal oxide clusters/nanoparticles based on Cu, Fe, Ag, Ni, and other non-noble metals (or their bimetallic compositions) to substitute Pd, Pt, Au and their role in catalysis of a wide range of chemical reactions with a focus on “greener” and atom-efficient processes producing chemicals in need. It is widely acknowledged that noble metals play a decisive role in industrial catalysis, with the size of nano-particles being of paramount importance. On the other hand, the role of Fe, Cu, Ag and Ni nanoparticles is investigated to a much lesser extent and remaining in dim lights: there is no clear-cut understanding on whether the proper design of the non-noble nanoparticle by playing with the ligand nature, size and morphology of NP, as well as with the electronic effects in bimetallic particles can lead to alternative catalysts comparable or better in terms of their performance than the conventional catalysts containing critical metals (Pd, Pt, Au and the like). If such metals would be replaced by non-noble metals or their oxides, without sacrificing the activity and selectivity of the catalysts, this would be a great breakthrough in technology taken into account a synergy with the reduced footprint due to the reduced energy consumption that is otherwise spent for the production and recovery of noble metals. Heuristic design of such novel catalysts may lead to a totally new approach that will make the catalysts much more efficient and non-expensive. The research should result in a new approach that is fundamentally different by its nature from the trial and error method enabling the tailored design of catalytic materials without numerous trials. This fundamental understanding will largely save material resources. Despite a great leap ahead with respect to theoretical and practical significance of the use of non-noble metal NP in catalysis, the most important problems still remained on sideways due to a high complexity and multidisciplinary character. The research should enable to fabricate new materials in a way that has never been achieved, to slash the cost and materials spent as far as the chemical reactions are concerned and to design new highly efficient catalytic systems. The work should help to unravel new avenues in technology leading to many useful applications in medicine, pharma, chemical engineering, and other sectors. Besides it should help to find a synergy between the activities of the research consortia, involving partners from Russia, the EU and/or associated countries to the FP7. The novel materials should be validated and upcaled by the potential end-users.
The research should have a strong industrial dimension that will support a permanent check on users’ acceptance.

7. **Nanomaterials and technologies for memory devices**

This topic concerns the development of new technologies for memory devices and transferring of data based on nanostructures. It also includes new technologies and approaches for quantum computing. Such technologies will result in low spatial dimensions and cost effective storage devices and high bit rate of data transfer. An advantage of nanotechnology memory storage devices, in contrast to the current devices, is their low energy consumption. It is expected that research on this topic will ensure leadership for EU countries, for Russia, and for countries associated to the EU’s FP7 in this area in the future.

8. **Interdisciplinarity of nanotechnologies**

The complex character of the problems that people face in the course of socioeconomic development requires respective approaches, i.e., “meta-“ or interdisciplinary ones. “Interdisciplinary” is not only a “fashionable” notion, but in many senses “a must”; for example novel materials for diagnostics having a substantial effect on the issues related to health problems and socioeconomic studies.

Another “combined” approach can be related to novel nanomaterials and respective technologies for solution of environmental problems, including (but not limited to): 1) treatment of different types of waste, including radioactive, industrial, household etc.; 2) environmental remediation; 3) recycling, also with production of valuable nanocomponents; 4) water purification aimed at production of drinking water and water used in food industry.

The mentioned materials are in many cases nanosized and include the following classes: 1) sorbents; 2) flocculants; 3) nanofilms; 4) nanocomposites; 5) nanocoatings (protective, anti-scaling, anti-wear etc.), and others.

It appears reasonable to leave some space for opportunities for “inter”-approaches combining efforts from researchers specializing in different fields of science and technology.
### ERA.Net RUS Thematic Workshop Nanotechnology – Voting of challenges and topics

<table>
<thead>
<tr>
<th>No.</th>
<th>Research Area</th>
<th>Area (green) points</th>
<th>Specific research topics</th>
<th>Topic (blue) points</th>
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<tr>
<td>16</td>
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<td>Optical sensors</td>
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<td>magnetic sensors</td>
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<td></td>
<td></td>
<td>biosensors</td>
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<td>chemical sensors</td>
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<td>mechanical sensors</td>
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<td>10</td>
<td>Functional materials</td>
<td>5</td>
<td>membranes: for fuel cells (2 points), for water purification (1), for power plants (1)</td>
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<td>functional nanomaterials and coatings supporting the monitoring of the health of structures</td>
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<td>light weight materials (aviation, cars)</td>
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<td>construction materials with high protective properties</td>
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<td>Nanoelectronics, photonics</td>
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<td>nanomaterials for devices for storage: new nanomaterials and innovative solutions for storage, processing and transfer of data</td>
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<td>innovative materials for nanoelectronics</td>
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<td>nanomaterials for batteries: lithium, etc.</td>
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<td>laser materials from nanopowder</td>
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<td>nanomaterials and hierarchical nanostructures for regenerative medicine</td>
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<td>nano for better life and health</td>
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<td>skin and bone regrowth, organ replacement</td>
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<td>Personalised medicine</td>
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<td>Environment</td>
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<td>modelling toxicity of nanomaterials; nanomaterials for remediation and prevention</td>
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<td>safety of nanomaterials</td>
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<td>environmental safety: sorbents, flocculants, catalysts, coatings &amp; composites</td>
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<td>environmental safety: vehicles, etc.</td>
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<td>11</td>
<td>Development of new types of nanosize catalysts for deep /green processing of raw materials and recycling</td>
<td>4</td>
<td>yield improvement of natural and human made raw materials (waste)</td>
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<td>Nanodiagnosics</td>
<td>3</td>
<td>instrumentation, measurement and diagnostics: a) using nanomaterials for diagnostics, b) diagnostics of nanomaterials</td>
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<td>visualisation and verification</td>
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<td>quality of nanomaterials measurement</td>
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<td>innovative instrumentation for assessment of nanoscale structures and processes</td>
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<td>measurement techniques and protocols for quality assessment of nanomaterials</td>
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<td>8</td>
<td>New materials with high thermal stability; increased strength materials</td>
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<td>novel materials / hybrid materials for solar cells</td>
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<td>high efficiency devices for solar cells</td>
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<td>functional materials for solar energy: high efficiency, reliability and longevity of solar cells</td>
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<td>innovative solar cells with a competitive price</td>
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<td>15</td>
<td>Optical materials &amp; materials for making lighting equipment</td>
<td>3</td>
<td>Predictive models for nanomaterial design</td>
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<td>Modelling of toxicology</td>
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<td>12</td>
<td>Solar energy</td>
<td>2</td>
<td>better models; better generators and magnets</td>
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<td>magnetic materials</td>
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<td>power engineering</td>
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<td>electric materials with high thermal stability</td>
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<td>14</td>
<td>Development of technology readiness level (TRL) high value nanomaterials using high energy methods: high pressure, microwaves, high power lasers, ultrasounds</td>
<td>2</td>
<td>innovative / biomimetic materials, nanostructures and systems</td>
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<td>18</td>
<td>Modelling</td>
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<td>7</td>
<td>Promising materials for power and electrical engineering</td>
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<td>23</td>
<td>growth of nano-hetero epitaxy</td>
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<td>9</td>
<td>Improved mass and size characteristics of vehicle parts and infrastructure elements</td>
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<td>nanomaterials for vehicles and transportation</td>
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<td>17</td>
<td>Energy efficiency</td>
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<td>19</td>
<td>Extraction agents, adsorbants</td>
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<td>2</td>
<td>New materials to manufacture products with radically new properties</td>
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<td>6</td>
<td>Bio inspired materials, nanostructures and systems</td>
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<td>13</td>
<td>Production technologies based on molecular self-assembly / synthesis of materials</td>
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<td>20</td>
<td>General safety, safety of nanomaterials</td>
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<tr>
<td>21</td>
<td>Human enhancement</td>
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<tr>
<td>22</td>
<td>Interdisciplinarity</td>
<td>1</td>
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8.6.4 Consensus ERA.Net RUS Environment / Climate Change workshop, Moscow 17 May 2013

Environment / Climate Change topics for the ERA.Net RUS Plus call:
1. Increasing the reliability of regional climate projections: models and measurement
2. Environmental impact and risk of raw materials extraction and transportation
3. Extreme climate events and their impact on the environment

Short topic drafts

**Topic 1: Increasing the reliability of regional climate projections: models and measurement**
This topic includes tackling several independent issues for promoting the increase of reliability of regional climate projections. Improving the spatial resolution of climate models will allow simulating the short-term part of variability and taking into account mosaic conditions of the land surface. Developing a set of regional benchmark tests based on measurements will support performing validation of climate models. Finally, improving the data assimilation system (based on measurements) will enable enhancing of initial conditions for the task of short-term climate predictions.

**Topic 2: Environmental impact and risk of raw materials extraction and transportation**
Recent observations within the Arctic region show that the surface air temperatures continue to be higher than the 20th century average. The most striking change in the Arctic has been the decline of the summer ice. In 2008 both the Northeast and Northwest Passages had ice-free conditions for the first time in the recorded history. Researchers suggest that the Arctic may be sea ice free in September as early as 2030. The melting sea ice leaves the Arctic sea increasingly open for shipping and enables the usage of natural resources such as minerals, oil and gas. The growing activities in the Arctic has potentially dramatic increases in the man-made emissions and hence impacts on the vulnerable, distant environments. These activities face problems and will need knowledge in understanding weather phenomena, ice behaviour and ship navigation in ice conditions as well as how the climate change will proceed and the environment is impacted by the increased activity in the Arctic and subarctic area. Melting of permafrost will pose challenges in transport, as well as for gas and oil pipelines. Leaks in gas and oil pipelines and emissions from shipping may cause substantial local and regional pollution.
Therefore, research has to be performed and new, environmentally friendly technologies need to be developed such as closed system mining processes, oil drilling, energy transport (gas...
and oil pipelines), sustainable energy and waste management, communication and transportation. Vessel operators can benefit from timely delivery of environmental information, like satellite observations of sea ice cover and ice maps but will also require a degree of coordination with icebreaker services and vessel monitoring to ensure safe passage.

**Topic 3: Extreme climate events and their impact on the environment**
This topic concerns observed and projected changes in weather and climate extremes, including analyses of observed and projected impacts on the natural and agricultural environment: floods, extreme sea levels, coastal impacts, droughts, heavy snowfall and forest fires, heat waves, high-latitude including permafrost degradation. Studies are welcome of long-term changes of major indicators of climate, and comparative analysis of factors influencing it over Eurasia. Furthermore, studies of understanding the risks or opportunities of climate extremes for climate change adaptation are relevant.

**Additional /Perspective Topics**

4. **Climate impact on ecosystems (fisheries, land based agriculture)**

Climate change will impact not only natural ecosystems and their biodiversity, but also managed ecosystems, whether water based such as fisheries or land-based such as agrosystems and forest systems, and the goods and services they produce. This topic focuses on understanding climate change impacts and their related stresses, their prediction and effects on managed ecosystems.

Potential projects should focus on furthering our capability to understand, detect and predict the key risks to regional marine ecosystems using a comparative approach (e.g., Mediterranean, Black Sea, Baltic Sea, Barents Sea, North Sea) and the associated feedbacks to the Earth System, arising from multiple stressor interactions brought about by climatic and direct anthropogenic change.

For land based managed ecosystems, projects should focus on the feedback loop that agriculture and sylviculture can provide to climate change mitigation and adaptation. Process-based models should be improved, but also experimental designs, and although large spatial and temporal scales remain of primary interest, projects should also focus on smaller scales at which processes can be finely investigated and then integrated.

Another topic of interest is whether or not extensively managed forests, which constitute the backbone of European and Russian forestry, possess the evolutionary capacity and the community structure to adapt to climate change and which management scenarios, industry modification and policy adjustments are necessary to sustain these natural processes. Again, modeling and experimental approaches are relevant, and stakeholders have a major role to play for this topic. Contrasting scenarios among the many climate regions of Europe and Russia would be particularly relevant.

Conservation and sustainable development strategies are currently planned under static environmental and anthropogenic conditions. Understanding how evolving managed ecosystems can act as new reservoirs of biodiversity conservation under climate change is a key issue that needs addressing for keeping pace with international treaties.

5. **Prevention and remediation of pollution of aquatic systems**

This topic implies monitoring of water bodies and study of their condition, including both surface (rivers, lakes, seas, etc.) and ground waters. Research is required on the impacts of anthropogenic discharges on self-purification processes, and on formation of natural waters quality used for fish-breeding, drinking, technological scopes and/or irrigation. Prevention of eutrophication and of irreversible disturbance of water bodies’ balance needs analysis.
Research should be conducted on water-vegetation systems in view of remediating and stabilising their optimal life conditions. Studies are also welcome on the elaboration and perfection of biological, physical-chemical and mechanic methods to prevent municipal and industrial discharges in natural waters. This includes developing treatment systems for aquatic compartments polluted with toxic components, persistent organic pollutants, heavy metal compounds, and nutrients (nitrogen and phosphorus). Studies may focus on developing water saving and reusing systems. Another relevant issue in this context is the extraction of precious components from waste waters and obtaining of useful and commercial products as a result of this processing. Furthermore, impacts of landfills of domestic and production wastes on the formation of qualitative and quantitative composition of underground waters and people’s health may be studied. Attention may also be paid to waste stabilisation measures to prevent their leaching with atmospheric precipitates, and to processing of waste into useful products.

6. Climate and pollution in big cities

A majority of people live in big cities, megacities and agglomerations. Here, the effect of global warming increases, because climate changes and effects of pollution can in some cases interact synergistically. The development of a special forecasting system is required, which will provide forecasts of both weather and pollution conditions (including biologically active compounds). The forecasting needs to be combined with an evaluation of risk, health, and degree of comfort conditions. To validate such a system, a set of benchmark tests based on measurement needs to be developed.

7. Impact of transport/traffic on climate change and pollution

This topic concerns the influence and impact of transport/traffic on pollution and climate evolution. It includes all types of transportation (ground, ocean, air) and all types of emissions: greenhouse gases, pollutants, water vapour, etc., and correlative effects such as production of fogs, contrails, and aerosols. In particular, the retreat of the Arctic sea ice, besides impacting the climate in Europe and Japan, will offer opportunities for marine transportation and associated activities all along the coasts involved in the Arctic passages. This new marine transport/traffic will contribute to increase the direct pollution (both atmospheric and marine) as well as the risks of oil spill. Special attention will then be paid to studies dealing with the consequences of an increasing maritime transportation in the Arctic Ocean.
ERA.Net RUS Thematic Workshop Environment / Climate Change – Voting of challenges and topics (ranked by research area)

<table>
<thead>
<tr>
<th>No.</th>
<th>Research Area</th>
<th>Research Area (yellow) points</th>
<th>Specific topics</th>
<th>Topics (red) points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Understanding climate change and reliable climate projections (basic research)</td>
<td>9</td>
<td>long term research for climate change; long term studies (over 5 years)</td>
<td>6</td>
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<td>climate models and regional models</td>
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<td>systems approach</td>
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<td>3</td>
<td>Understanding the functioning of the ecosystem, and its interaction with the social system</td>
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<td>Anthropogenic pressure</td>
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<tr>
<td>5</td>
<td>Natural resources and climate</td>
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<td>environmental impact and risk of usage of raw materials</td>
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<td>wind, water, vegetation, permafrost</td>
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<td>climatically induced natural resources</td>
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<td>23</td>
<td>Impact of CC on Disasters</td>
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<td>Extreme climate events</td>
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<td>19</td>
<td>Pollution of waters</td>
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<td>2</td>
<td>Assess impacts, vulnerabilities and develop innovative cost-effective adaptation and risk prevention measures</td>
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<td>from prediction and projections to mitigation</td>
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<td>mitigation: eco-innovative technologies</td>
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<td>4</td>
<td>Provide knowledge and tools for effective decision making and public engagement</td>
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<td>visualisation and other tools: atlas (1 point), animated maps (1), scenarios, guidelines</td>
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<td>Climate impact on ecosystems (fisheries, land based agriculture)</td>
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<td>Develop competitive and environmentally safe technologies for CO2 capture, transport and storage</td>
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<td>Production efficiency and coping with CC while ensuring sustainability</td>
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<td>new devices for avoiding catching unwanted species</td>
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<td>reproduction of fish</td>
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<td>Increased economic activities in the arctic and environmental effects</td>
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<td>climate and microclimate: pollution in big cities</td>
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<td>Impact of climate change on wind energy production</td>
<td>conflicts with food production: question of land use</td>
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<td>wind speed - impact of climate change on wind energy production</td>
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<td>8b</td>
<td>Technology for wind energy</td>
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<td>Climate/Environment and transport</td>
<td>impact of transport/traffic on CC and pollution</td>
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<td>impact of CC on transport</td>
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<td>efficient energy use in transport</td>
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<td>22</td>
<td>Forest fires and other fires</td>
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<td>Water and land ecosystem resources</td>
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<td>6</td>
<td>Developing comprehensive and sustained global and environmental observation and information systems</td>
<td>monitoring of policy implementation, measure impact</td>
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<td>monitoring infrastructure, parameters, indicators</td>
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<td>define indicators for progress towards green economy</td>
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<td>11</td>
<td>Make bio-energy competitive and sustainable</td>
<td>impact of food production, bioenergy production</td>
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<td>emissions from wood burning</td>
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<td>Hydrogen and fuel cells technologies</td>
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<td>A sustainable and competitive agrifood industry</td>
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<td>Shipping and emissions in an ice free arctic</td>
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<td>Biodiesel/Biofuels</td>
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<td>Bring to mass market technologies and services for a smart and efficient energy use</td>
<td>conflicts regarding land use (caused by energy production)</td>
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<td>climate change impact on solar energy</td>
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<td>Impact of CC on solar energy production</td>
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<td>Technology for solar energy</td>
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<td>14</td>
<td>Empowerment of rural areas, support to policies and rural innovation</td>
<td>natural regeneration of forests, increase of forest area</td>
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<td>consequences from reforestation (e.g. on food production, etc.)</td>
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<td>social consequences: rural population decrease</td>
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