European Commission

Mutual Learning Exercise on National Strategies and Roadmaps for International Cooperation in R&I

International R&I cooperation policies revisited: sustained challenges and new developments

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Mutual Learning Exercise on National Strategies and Roadmaps for International Cooperation in R&I: International R&I cooperation policies revisited: sustained challenges and new developments

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EUROPEAN COMMISSION

Mutual Learning Exercise on National Strategies and Roadmaps for International Cooperation in R&I

International R&I cooperation policies revisited: sustained challenges and new developments

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1 Executive summary

Purpose and background

The overall purpose of this Mutual Learning Exercise (MLE) is to increase the capacity of EU Member States and Associated Countries to formulate and implement national strategies and roadmaps for international cooperation in research and innovation (R&I) and thereby create favourable conditions for the production of new knowledge that can inform and guide broad groups of policy-makers. In countries where there are no formal international strategies or roadmaps for international cooperation in R&I, the results of the MLE should be addressed within relevant fora for strategic policy discussions on international cooperation in R&I.

Representatives of ministries for higher education and research and/or research and innovation funding agencies from the following EU Member States and Associated Countries participated in the MLE: Austria, Belgium/Flanders, Denmark, Finland, France, Greece, Hungary, Ireland, Moldova, Norway, Portugal, Romania, Slovenia, Sweden and Turkey.

Main findings – current situation and recurring challenges in international R&I

- Most countries have an internationalisation strategy or roadmap which includes countries both inside and outside Europe. The focus is on the following objectives, in order of priority: (1) excellence in research, (2) science diplomacy, (3) development of the European Research Area, (4) global challenges and (5) innovation. The trend is for innovation-related objectives to become more important in international R&I cooperation while the combination of academic knowledge production and business-driven innovation is still a challenge.
- In general, countries prioritise cooperation with top R&I performers and a few emerging economies, usually those with large domestic markets. Ongoing cooperation with China, India and the US is common. Other frequently mentioned partners include Brazil, Russia, South Africa, Japan, South Korea, Canada, Chile and Argentina. The selection of partner countries is usually based on a combination of political considerations originating from R&I and/or foreign policy priorities, evidence-based analysis, and initiatives emerging from individual or institutional networks within research and innovation communities.
- Science, Technology and Innovation (STI) agreements are frequently used as a tool for the promotion of international cooperation in R&I. The arrangements are usually bilateral, and it is very rare that two or more European countries are involved. The critical factors for success in an STI agreement are considered to be the following, in order of priority: (1) mutual interests of the beneficiaries, (2) alignments between implementing agencies and (3) political commitment and budgets. The unsuccessful cases often are characterised by a lack of reasons for the agreement, beyond the diplomatic ones, combined with a lack of responsibility for its implementation and/or the absence of a demand for cooperation in the research and innovation

communities. Most of the unsuccessful agreements are so-called 'empty shells' where implementation has failed because of inactivity due to changing political situations, lack of budget or reduced interest from R&I communities. The MLE participants do not consider 'empty shells' to be a big problem, but they might still be a burden for those who administer them.

- Both bottom-up and thematic research nowadays address broad topics such as climate, health, energy etc., and are also increasingly dependent on the sharing of research infrastructure. It is therefore considered beneficial to make use of a range of available domestic programmes and instruments in international R&I cooperation.
- A broadening of the scope of national strategies and roadmaps for international cooperation in R&I has many implications. An obvious requirement is the increased involvement of stakeholders from different branches of government, as well as from funding agencies, academia and business. It also calls for more coordination activities, especially during implementation. As stakeholder engagement in partner countries is most often considered to be the responsibility of the partner country, there is also a need for joint partnership platforms or other arrangements for cross-national coordination.
- Monitoring and evaluation of progress during the implementation of international cooperation in R&I is of crucial importance, but the availability of data, especially in countries outside Europe, is very limited. There is an urgent need for monitoring and evaluation standards and guidelines as well as for the co-creation of indicators which take into account the need for different indicators related to the different goals.

Main findings – new trends in challenge-driven international R&I cooperation

- There is increased focus on challenge-driven R&I, both at national and European levels. This is markedly influenced by the UN Agenda for Sustainable Development, which includes 17 Sustainable Development Goals (SDGs). Two of them address structural transformations of governmental arrangements within and between states, markets, civil society and science communities, and these are judged to constitute 'framework conditions' for reaching the other 15 SDG goals, which focus on thematic areas such as education, health, climate action and on long-term fundamental changes, e.g. overcoming hunger and poverty, etc.
- The MLE participants acknowledge that nowadays Europe is facing global system changes and challenges that cannot be overcome in an individual country and that it is, therefore, important to jointly contribute to making informed policy decisions, based on research and innovation, in order to improve the situation. While this calls for challenge-driven international cooperation in R&I, the SDG framework conditions, and the entire SDG agenda, are not given precedence over nationally prioritised goals. Still, thematic SDGs such as health, energy and clean water are sometimes highly ranked in national strategies for international cooperation in R&I.

- Challenge-driven cross-border collaboration is increasingly being reflected in activities at inter-ministerial level and sometimes at inter-agency level as well. Multi-stakeholder funding partnerships are also built with private partners that focus on close-to-market activities as well as with philanthropic institutions. Most MLE participants find multi-stakeholder funding partnerships with private and third sector entities relevant, but few of them report that their country is experienced in developing these, especially with a view to international R&I cooperation.
- Although increasingly emphasised as a priority, the goals of science diplomacy remain vague. Examples of subsumed goals include the building of scientific bridges in times of conflict, strengthening historically good relations and working on common standards for market access and trade agreements. Sometimes there are more ambitious goals intended to help partner countries develop into knowledge societies which, in the longer term, might become mutually beneficial. Some MLE participants report that they apply or partly apply this approach, but in most of the countries this is not the case because the information links between ministries for foreign affairs and those responsible for international R&D are still too weak.
- The MLE clearly showed that new value-based principles and requirements are emerging in international R&I cooperation and that this development is bolstered by the attention to challenge-driven international cooperation in R&I. Also, the increasing number of STI agreements and the awareness of the importance of social impact, multidisciplinary research activities and cross-industry connections are, to some extent, considered to be caused by increased emphasis on challenge-driven international cooperation in R&I.
- The EU is perceived to be a strong supporter of 'good principles', such as excellent research, research ethics, open access and gender equality, etc. In addition, it is seen as a global driver for making 'value-based' standards applicable in partner countries, and for reciprocity in funding and access to research infrastructure in international R&I cooperation, especially with regard to cooperation between developed countries.

Conclusions

- The focus on 'design and development', 'tools' and 'framework conditions' for the formulation and implementation of national strategies and roadmaps for international cooperation in R&I filled an important knowledge gap and constituted a basis for enabling the MLE participants to gain information on good practices and priorities within areas of relevance for them.
- Most participants agreed that the experiences gained inspired them to rethink some aspects of their work within the area of international cooperation in R&I and to make attempts to further improve the basis for the production of new high-quality knowledge, as well as for important innovation activities.
- There is considerable variation among European countries with regard to cultural, political, economic and other preconditions for international cooperation in R&I. The ambition to learn from each other as to how to cooperate across territorial and other borders is therefore not easily

accomplished. Although multilateral coordination and cooperation between Member States and Associated Countries is high on the agenda, it is difficult to realise due to these variations, but also because of insufficient support structures and policies.

- The results of this MLE, including the agreed recommendations listed below, show that exchange of information and respectful dialogue makes it possible to gain insights that will increase the capacity to formulate and implement national strategies and roadmaps for international cooperation in R&I, and thereby strengthen the basis for multilateral cooperation and informed policy-making inside the participating countries – and probably also among their partners in Europe and beyond.

List of recommendations

Based on the findings of this MLE and the conclusion, the following recommendations have been proposed by the expert panel:

Recommendation 1: *Apply a clear intervention logic to substantiate international R&I cooperation strategies*

Recommendation 2: *Reinforce strategic alignment of domestic policies to meet R&I internationalisation rationales*

Recommendation 3: *Co-develop strategies*

Recommendation 4: *Implement effective cross-governmental coordination and multi-level participation processes*

Recommendation 5: *Secure sufficient resources for multilateral R&I coordination and internationalisation activities*

Recommendation 6: *Monitor and evaluate international R&I cooperation policies*

Recommendation 7: *Promote SDGs and challenge-driven R&I in international R&I cooperation*

Recommendation 8: *Explore multi-stakeholder funding with private and third sector entities*

Recommendation 9: *Valorise and operationalise science diplomacy for enhanced effectiveness*

Recommendation 10: *Invest in relationship management and stakeholder engagement*

Recommendation 11: *Establish joint action on 'good principles' in international R&I cooperation*

Recommendation 12: *Integrate foresight in national funding practices and develop international joint foresight activities for R&I cooperation*

Recommendation 13: *Empower SFIC to play a more active role in the coordination of joint R&I internationalisation activities*

2 Introduction

This is the Final Report of the Mutual Learning Exercise on National Strategies and Roadmaps for International Cooperation in Research and Innovation (R&I), implemented under the Horizon 2020 Policy Support Facility. It summarises and reflects the main policy challenges and practices in the field of international R&I cooperation policies. It also provides recommendations on how to further boost international R&I cooperation in and between EU Member States and countries associated to Horizon 2020.

Mutual learning refers to exchanging, debating and learning from practices used by peers, which are of interest to several European Union (EU) Member States and countries associated to Horizon 2020. Its aim is to identify good practices, lessons learnt, and success factors based on robust evidence.[1] The participants of this MLE came from different countries and organisational backgrounds. Most of them were from ministries in charge of international R&I cooperation and some from agencies in charge of policy delivery. Table 1 provides an overview of the MLE participants:

Table 1: Participants of the MLE on National Strategies and Roadmaps for International Cooperation in R&I

Country / Region	Organisation
Austria	Austrian Federal Ministry of Education, Science and Research
Belgium/ Flanders	Flanders Research Foundation (FWO)
Denmark	Danish Agency for Science and Higher Education
Finland	Ministry of Education, Science and Culture and Ministry of Economic Affairs and Employment
France	French Ministry of Higher Education, Research and Innovation
Greece	General Secretariat of Research and Technology (GSRT)
Hungary	National Research, Development and Innovation Office
Ireland	Department of Business, Enterprise and Innovation
Moldova	Academy of Sciences of Moldova/Council of Rectors in Moldova
Norway	Research Council of Norway and Norwegian Ministry of Education and Research
Portugal	Fundação para a Ciência e a Tecnologia, I.P.
Romania	Ministry of Education and Research
Slovenia	Ministry of Education, Science and Sports
Sweden	Ministry of Education and Research and Swedish Innovation Agency Vinnova
Turkey	The Scientific and Technological Research Council of Turkey (TÜBİTAK)

[1] Definition partly taken from https://rio.jrc.ec.europa.eu/en/policy-support-facility/mutual-learning; accessed on 18 July 2019.

Based on input provided by the country representatives and experts at a kick-off meeting in the middle of March 2019, it was decided to deepen rather than broaden already existing knowledge on national strategies and road maps for international cooperation in R&I.

This report draws from the rich expertise of the participants of this MLE. Views on identified challenges and new developments, including inspiring practices, were actively shared, especially during the three country visits to France, Romania and Sweden. During the country visits, which were hosted by the French Ministry of Higher Education, Research and Innovation, the Romanian Ministry of Education and Research and the Swedish Ministry of Education and Research, different dialogue, engagement and discussion tools were operationalised to exploit exchanges between and the creativity of the participants.

At these meetings, comprehensive information on national strategies and roadmaps for international cooperation in R&I was provided by participants from the countries that were visited, as well as by participants from a number of other countries. The content of the reports was discussed, and additional information was exchanged during these seminars.

Prior to the country visits, the experts involved in this MLE carried out extensive desk research and contributed input in the form of 'Challenge Papers', which were afterwards fully elaborated in 'Thematic Reports', which can be downloaded from the PSF website.[2] One-page summaries of these Thematic Reports are annexed to this Final Report.

The three Thematic Reports constitute the basis for the Final Report, which was discussed in draft form at a meeting at the beginning of February 2020. Written comments from the country representatives were thereafter provided and the report was finalised.

This MLE was structured along three interconnected topics:

1. The *design and development of national strategies for R&I international cooperation* focusing on embedding international R&I policies in national R&I strategies; the alignment of instruments; R&I internationalisation objectives; monitoring and evaluation

2. How to *design Science and Technology Agreements and how to make best use of them* in implementing national strategies for R&I international cooperation

3. How *challenge-driven thematic approaches and framework conditions for R&I international cooperation* (such as reciprocity, intellectual property rights, openness of national research programmes to entities

[2] https://rio.jrc.ec.europa.eu/en/policy-support-facility/mle-national-strategies-and-roadmaps-international-cooperation-research-and

from other countries, open science, ethics, etc.) are catered for within international R&I cooperation

A considerable amount of input in terms of taking stock of the current practices of the MLE participants was gathered through three surveys that were carried out prior to the country visits.

- Survey 1 dealt with important aspects related to the design and development of national strategies for international R&I cooperation.

- Survey 2 investigated the substance, structure and use of Science and Technology Agreements (STA), differentiating between successful and less successful approaches and examples. In order to identify critical success factors of STI agreements the MLE participants provided detailed information on a number of their active and inactive agreements.

- Survey 3 finally scrutinised the attitudes, practices and uptake of challenge-driven approaches, as well as existing and novel 'good principles' in international R&I cooperation.

Since the MLE participants are diverse in terms of their competences, roles and functions, it has to be clearly stated that **not all recommendations are necessarily relevant for all**. Moreover, this MLE includes both more and less advanced countries in terms of R&I; it includes also larger and smaller countries and even a region, which may have different internationalisation objectives, policies and tasks. It includes organisations which are more receptive to (basic) research and some more prone to innovation, and ministries, quasi-ministries, agencies with quite broad autonomy and other entities. Even though our recommendations include an indication of the actors in the governance system to which they are directed ('addressee'), **they have to be translated by the MLE participants themselves according to their specific competences and characteristics.**

When referring to R&I internationalisation in general, we need to make an important distinction between R&I internationalisation in the business sector, the public R&D sector, and the sphere of R&I internationalisation policies. While most of the literature on R&D internationalisation focuses on multinational enterprises and economic activities (Dachs 2017, De Backer et al. 2016, OECD 2010, Hall 2010, Hatzichronoglou 2008; OECD 2008a; OECD 2008b; OECD 2008c; Shapira et al. 2009, OECD 2005, UNCTAD 2005, Archibugi and Iammarino 1999, Birkinshaw and Hood 1998; Birkinshaw et al. 1998), a much smaller part of the literature deals with R&I internationalisation policies and, in particular, international comparisons of R&I internationalisation policies (CREST Working Group 2007, OECD 2008a, TAFTIE 2009, Schwaag-Serger and Wise 2010, Schwaag-Serger and Remoe 2012, OECD 2016a, SFIC 2018 and SFIC 2019).

In the following deliberations we focus on R&I internationalisation policies and not on R&I internationalisation in general.

3 Sustained challenges for international cooperation in R&I revisited

Chapter 3 scrutinises the state of the art in terms of planning and implementing international R&I cooperation. Its focus is primarily on sustained challenges for international cooperation in R&I, which are usually well-known. For most of them, inspiring practices for solutions could also be identified. This chapter deals in particular with the rising complexity of R&I internationalisation strategies, which increasingly show a mix of traditional and new upcoming objectives. This resulting diversity in objectives, however, calls for clear intervention logics, a smart embedding of internationalisation approaches in national R&I strategies, and cross-governmental and multi-level participation approaches. At the operational level, the complexity challenge needs to be approached through an evidence-based selection of international partner countries and thematic priorities, the alignment of international R&I cooperation policies with national R&I policies, and an optimised use of European structures and policies for joint activities. To improve existing policies, the current practice for the evaluation and monitoring of international R&I policies and their outcomes needs to be further developed and enhanced.

3.1 Increasing complexity of R&I internationalisation strategies

3.1.1 Objectives of R&I internationalisation policy

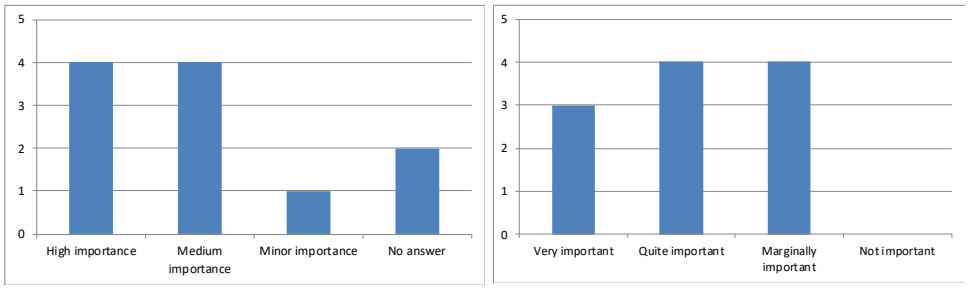
National and European policy-makers share the view that the global competitiveness of an R&I location today largely depends on how well it is integrated into international knowledge flows and value chains. Thus, not surprisingly, most EU Member States participating in this MLE have a dedicated R&I internationalisation strategy or at least a chapter on international cooperation in R&I in their national R&I strategy. Usually, in most strategies and roadmaps, R&I internationalisation cooperation targets both intra-European cooperation and cooperation with international partner countries outside the EU. Eight of eleven respondents mentioned that the aspect of internationalisation within the overall national R&I strategy is very important or at least of medium importance (see Figure 1, left hand side). The 'no answer' responses are caused by MLE participants who do not have an overall national R&I strategy. If asked, however, how important the internationalisation of research is within the strategic policy discourses in their countries, then the picture becomes more blurred (see Fig. 1, right hand side).

The literature (Boekholt et al., 2009; CREST, 2007) suggests that most of the R&I internationalisation strategies of EU Member States focus on the 'Excellence Objective', 'Market (or innovation) Objective', 'Global (or Grand) Challenges Objective' and 'Science Diplomacy Objective'. MLE participants confirmed this assessment but added the 'Development of the ERA Objective' (see Fig. 2). In addition, the 'Cost and Risk Sharing Objective' was also mentioned a few times, but not listed among the four main R&I internationalisation objectives by any of the countries which responded to the first survey.[3] This, however, might also

[3] Therefore, it is not considered in the rankings and not shown in Figure 2.

point to the terminology being unclear. It primarily refers to efforts for which critical mass is needed and which can hardly be tackled by one country alone due to the overwhelming financial and/or risk burden (e.g. development and operation of large research infrastructure).

Figure 1: Importance of R&I internationalisation within the national R&I strategy (left) and within the national strategic policy discussions (right)



Source: First survey sent to MLE participants, n=11

The MLE participants focus mostly on the following main objectives (in descending order; see Figure 2):

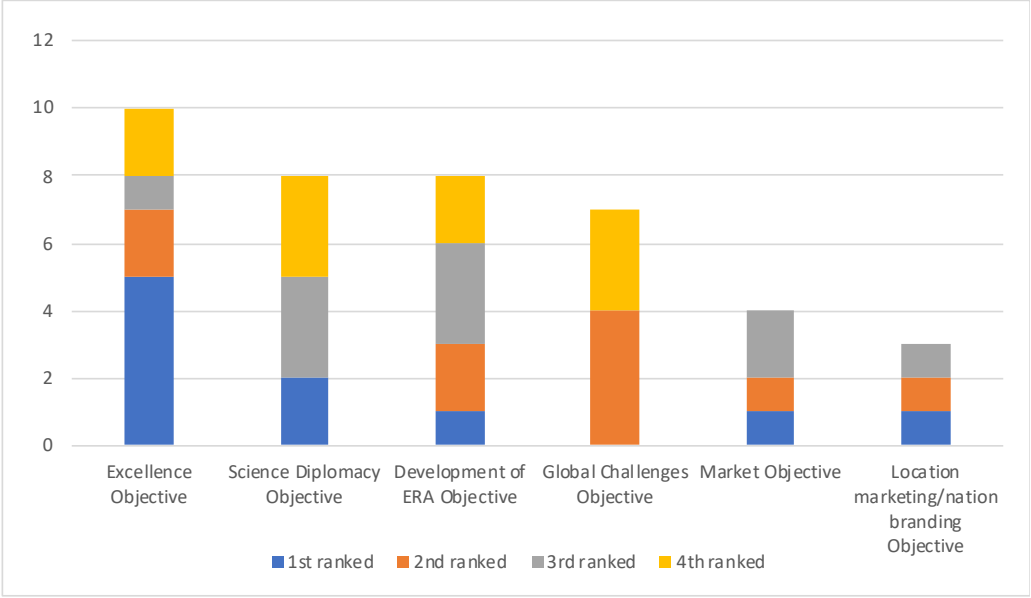
1. Excellence Objective
2. Science Diplomacy Objective
3. Development of the European Research Area Objective
4. Global (or Grand) Challenges Objective
5. Market (or Innovation) Objective (in combination with the Location Marketing (or Nation Branding) Objective).

The objectives can be differentiated by a narrow and a broader STI cooperation paradigm (Boekholt et al, 2009). In the narrow STI cooperation paradigm, the drivers for international research collaboration policies aim to improve the quality, scope and critical mass in science and research by linking national resources and knowledge with resources and knowledge in other countries. Here, the drivers originate from within the science community and are translated into science and research policy instruments. Thus, the 'Excellence Objective' would be the 'purest' narrow STI cooperation objective.

In the broad STI cooperation paradigm other non-science policy objectives also interact with the 'intrinsic' science-oriented paradigm and STI cooperation becomes a means to reach other policy ends. According to Boekholt et al. (2009) these other policy ends relate to (i) improving national competitiveness, (ii) supporting less developed countries by developing STI capabilities, (iii)

tackling global societal challenges and (iv) creating good and stable diplomatic relationships.[4]

Figure 2: Ranking of R&I internationalisation objectives



Source: First survey sent to MLE participants; own calculations; n=11

Sometimes the objectives mentioned above are complemented by objectives that point to a country's specific problem, need, capacity or agenda. A good example is the new German internationalisation strategy, which puts a special emphasis on supporting vocational education and fighting labour shortage (in Germany but also in places where German companies are located abroad). Another example is Switzerland, which prioritises the recognition of diplomas in its international strategy for education, research and innovation to facilitate 'brain gain' (Sigl and Witjes, 2014). Among the countries participating in this MLE, Hungary, for instance, indicated, as a further objective, a better harmonisation with strategic industrial development goals and Slovenia, as another example, stated the alignment between the European Research Area (ERA) and the European Higher Education Area (EHEA) and a better connection of internationalisation policies with the cohesion funds as further objectives.

During the MLE discussion it also became clear that the emphasis is changing in current R&I internationalisation policy. While R&I internationalisation policy had exclusively positive connotations in the past, it is now much more geared towards concrete outcomes and a growing sensitivity towards cooperation with certain countries.

[4] A detailed description on the relevant objectives for international cooperation can be found in Schuch (2019).

3.1.2 The notion of innovation

What also became very clear through this Mutual Learning Exercise was that innovation-related rationales in particular are becoming more prominent in current R&I internationalisation thinking. This is caused by a more economic understanding and rationale of Science and Technology (S&T) policy-making in general. It is, however, also propelled by the challenge-driven approach (see Section 4.1) where the bridging from research to innovation-related activities in different social spheres (e.g. market-related innovation; social innovation; public sector innovation, etc.) is regarded as an essential integrating element.

The notion of innovation, however, is disruptive to traditional international S&T policy strategies, as confirmed by the majority of MLE participants (Schuch, 2019). Although recognised as a strong driver of economic growth and structural change, innovation also creates winners and losers, whereas international S&T policy typically aims to support pre-competitive mutual benefit through cooperation in fundamental sciences. Accordingly, the specific instruments to foster international R&D cooperation were and still are focusing on areas of basic research and international mobility of researchers and students, consciously distanced from immediate commercial interest. Even when mentioned in some 'older' internationalisation strategies, economy-relevant approaches were until recently primarily focused on attracting inward Foreign Direct Investment (FDI) or on facilitating both inward and outward technology transfer (depending on the position of the country under scrutiny in international value creation chains), but not so much on supporting the innovation-based expansion of businesses.

All MLE participants agreed that it is still a special challenge to bring the different spheres of 'academic knowledge production' and 'business-driven innovation practices' together and to develop R&I internationalisation approaches that combine these spheres (possibly also including public sector innovation, social innovation and common public good aspects). Two of the eleven participants responding to the first survey mentioned that 'innovation' and 'science' are 'worlds apart' in their internationalisation practices and four more countries confirmed that this is at least partly the case. Only around half of the responding countries explicitly target the internationalisation of their domestic MultiNational Enterprises (MNEs) with specific R&I instruments or programmes. And of these, only France assigned high importance to this. France was also the only responding country which assigned high importance to the internationalisation of domestic Small- and Medium-sized Enterprises (SMEs) with specific R&I instruments or programmes. Seven other responding MLE countries also explicitly targeted SMEs with specific R&I instruments or programmes but assigned only limited importance to it.

3.1.3 The quest for a clear intervention logic

International R&I cooperation should be designed as strategically as possible in order to achieve the best possible impact. A central feature of a strategy is that it defines clear goals, which go beyond the wish to simply increase international R&I cooperation, because international cooperation is usually not considered to be an end in itself. Thus, the most fundamental question refers to what should be achieved with international R&I policy cooperation (e.g. the overall

objectives) and which intervention logic is applied when Research and Development (R&D) internationalisation policies are developed and implemented.

A clear intervention logic (e.g. based on a Theory of Change) helps to lay out the sequence of outcomes that are expected to occur as a result of an intervention made by applying clear policies. In other words, a logical deduction for an intervention pathway should be developed, starting with high-level objectives and rationales about the expected change that the policy intervention should trigger or enforce, which is then broken down into specific activities, measures and outputs that are supposed to drive the change.

The quality of an intervention logic can be approximated by *plausibility* (e.g. the logic of the impact pathway in terms of outcomes), its *feasibility* (e.g. can the proposed interventions realistically achieve the expected mid- to long-term outcomes?) and *testability* (which refers broadly to the indicators).

The first survey among the MLE participants, however, showed that only a few of the responding countries fully apply a Theory of Change for their international R&I cooperation strategy (Schuch, 2019).

Most R&I internationalisation strategies seem to propose rather broad objectives, while indications as to concrete outcomes, approaches, operational measures and proposed or available resources are often lacking. R&I internationalisation strategies that explicitly include plausible, feasible and testable intervention logic-based approaches (such as logical frameworks, logic charts or Theory of Change) are considered as being more credible and action-oriented by their target groups than vaguely formulated strategies, which may promise a lot but do not make pathways to achievement traceable.

R&I internationalisation strategies using intervention logic processes also enable easier tracking of whether the expected outcomes have been actually achieved (or not) and can be better evaluated (see also Recommendation 6).

The lack of an explicit intervention logic might also aggravate coordination among the different stakeholders involved in the development and implementation of an R&I internationalisation strategy, because stakeholders might have different intervention logics in mind, although this is not bad *per se* as long as they are known (and thus debatable and in a synergetic way 'harmonisable') and do not contradict each other.

Recommendation 1: Apply a clear intervention logic to substantiate international R&I cooperation strategies

The recommendation is to take a clear intervention logic-based approach in the process of developing R&I internationalisation strategies or roadmaps. How to make use of a broad understanding of innovation, and operationalise it for the purpose of an inclusive and effective international R&I cooperation, should be scrutinised in particular.

Addressee: The national R&I policy-making level responsible for establishing a strategy or roadmap for international R&I cooperation and the designers of specific policies (e.g. R&I cooperation programmes, instruments or initiatives).

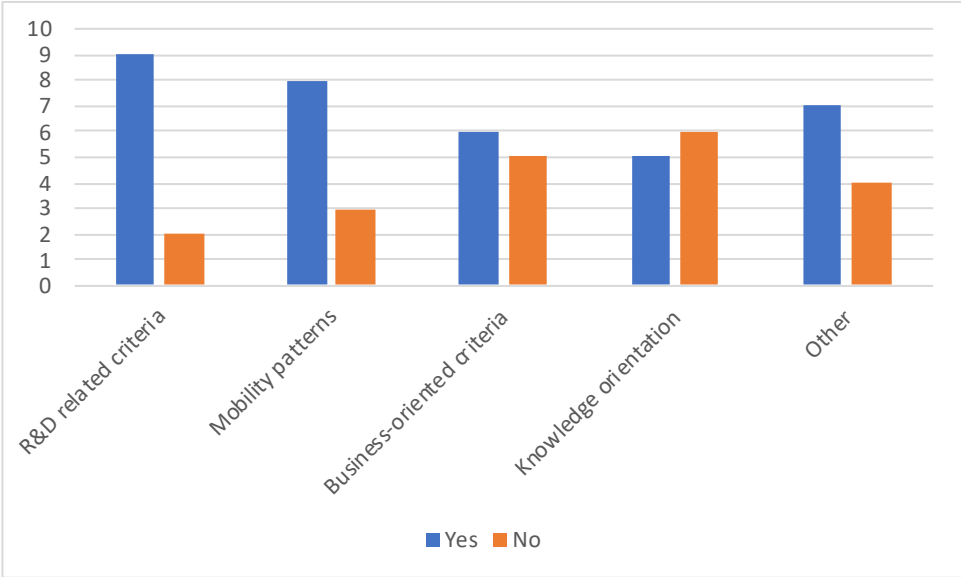
3.2 Evidence-based selection of international partner countries and thematic priorities

Empirical findings show that international partner countries are not strictly selected on the basis of quantitative scientometric indicators only and there is evidence of well-grounded scepticism among experts about cut-and-dried indicator-based selection approaches. It is also argued that R&D-related criteria for the selection of partner countries are biased to the detriment of emerging countries, for which it can be assumed that the area of 'dark knowledge and innovation' – e.g. those innovative activities that are not or cannot be covered by existing indicators – is particularly high (Sigl and Witjes, 2014).

Sigl and Witjes (2014) have elaborated a complex set of criteria for the selection of international partner countries. They differentiate between quantitative and qualitative criteria. The quantitative criteria include co-publications, impact factors, position in scientific ranking; co-patenting; mobility patterns; good (financial) governance; GDP, Gross Domestic Expenditure on Research and Development (GERD) and Higher Education Expenditure on Research and Development (HERD); and percentage of researchers and students out of the total population. The qualitative criteria are formulated as questions, which basically refer to the most important R&I internationalisation objectives. Most of these criteria were scrutinised during the preparation of the Austrian 'Beyond Europe' R&I Internationalisation Strategy (Austrian Federal Ministry of Science et al, 2013). Criteria for the selection of partner countries are not usually published in R&I internationalisation strategies. An exception is the approach adopted by the European Commission, which published criteria in its strategic communication entitled 'Enhancing and focusing EU international cooperation in research and innovation: a strategic approach' (COM (2012) 497).

In most cases the selection of partner countries by MLE participants is a combination of top-down and bottom-up priorities supported by indicator-based considerations: top-down in the sense of a selection based on broad political considerations (often originating from foreign policy rationales or R&I rationales) and bottom-up in the sense of focusing on the institutional and personal knowledge networks of the research community.

Figure 3: Indicator classes used for the selection of partner countries



Source: First survey sent to MLE participants; own calculations; n=11 (multiple answers)

Figure 3, above, shows that the majority of the MLE participants who responded to the questionnaire mostly use R&D-related criteria such as co-publications, impact factors or positions in scientific rankings. These criteria strongly relate to the excellence objective of R&I internationalisation strategies. In addition, mobility patterns are widely used. Business-oriented criteria (such as GDP growth, market size) and criteria related to knowledge orientation (such as the percentage of students and researchers out of the total population) are also used, but at lower overall levels. The category 'other' includes various dimensions, such as a potential international partner country belonging to a specific region (e.g. the neighbourhood) or having a specific socio-economic status (e.g. BRICS).

The Fonds Wetenschappelijk Onderzoek (FWO) (Belgium/Flanders research foundation) also mentioned political stability and other qualitative criteria, such as experiences of other European funding agencies or the demand for cooperation articulated by the research communities. Some countries (Austria, Greece, Hungary and Ireland) mentioned the importance of previous cooperation experience and already existing collaboration activities. Greece referred to the importance of the Greek diaspora in this respect.

Five of the responding MLE participants thought that more or better indicators would not make a significant difference in selecting partner countries. The others believed that it would partly make a difference.

The majority of the MLE countries responding to this first survey have already – at least once – had the experience that a potential partner country addressed by them refrained from entering into formal research policy cooperation.

Interestingly, both strong and weak R&D performing countries experienced refusal.

Therefore, in the quest for the selection of partner countries to cooperate with, the following questions also need to be raised and answered:

What makes us attractive for R&I cooperation?

What can we offer to the potential partner countries (also in practical terms)?

Nine of the eleven MLE countries responding to the first survey have at least partly formulated a concept as to why potential international partner countries should cooperate with them. France, for instance, has a research marketing strategy in place at the national level as part of its global science diplomacy strategy (further examples can be found in Schuch, 2019).

If made explicit, R&I internationalisation strategies repeatedly refer to more or less the same countries. This is also confirmed by the Strategic Forum for International Cooperation (SFIC) survey on Tools and Policies in International S&T Cooperation (2018) and by the SFIC Working Group on the Benchmarking exercise on strategies and roadmaps for international cooperation in R&I (2019). Most EU Member States/Associated Countries have ongoing cooperation relations in science, technology and innovation with China, India and the USA. Other regularly mentioned international partner countries are Brazil, Russia, South Africa, Japan, South Korea, Canada, Chile and Argentina.

Larger countries with a strong economic basis seem, in general, less restrictive than smaller countries with fewer capacities (also in administrative terms).

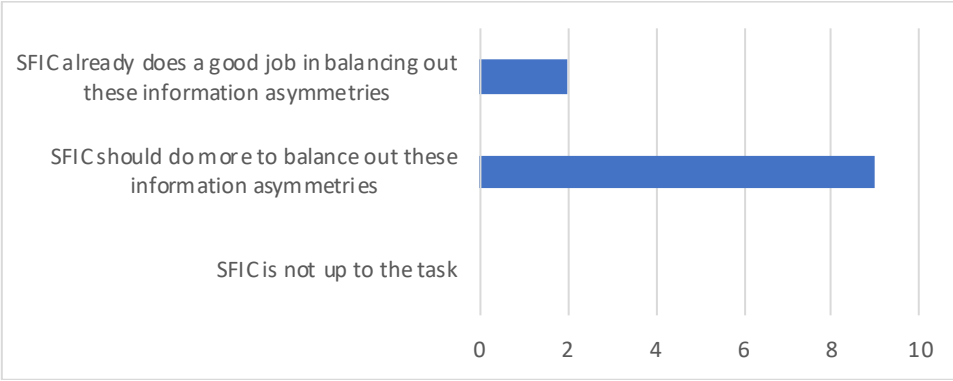
In general, the country prioritisation includes top R&I performers and a few emerging economies (usually the ones with a large domestic market), which nobody wants to miss out on cooperating with. Such orientation towards more or less the same countries can lead to the following two effects:

- First, the potentially attractive non-European countries select the EU Member States that propose cooperation simply based on opportunity rationales (similar to the drivers in the EU Member States) or limit the number of cooperation agreements in order to maintain handling capabilities and not to overburden their administrative capacities.

- Second, cooperation patterns where many EU Member States establish a bilateral cooperation with one attractive partner country (e.g. China) create information asymmetries. The one preferred international partner country will have aggregated information on its cooperation with the EU Member States, but no single EU Member State will have sufficient information about the activities of the other EU Member States with the same partner country, unless some information exchange mechanisms among the EU Member States are introduced (which was – *inter alia* – a major reason for establishing the Strategic Forum for International Cooperation – SFIC).

Figure 4 clearly shows that SFIC is already active in balancing out these information asymmetries, but by far the most respondents to this first survey answered that more should be done (see Section 4.7 and Recommendation 13).

Figure 4: Performance of SFIC in balancing out information asymmetries of EU MS about certain international partner countries (e.g. BRICS)



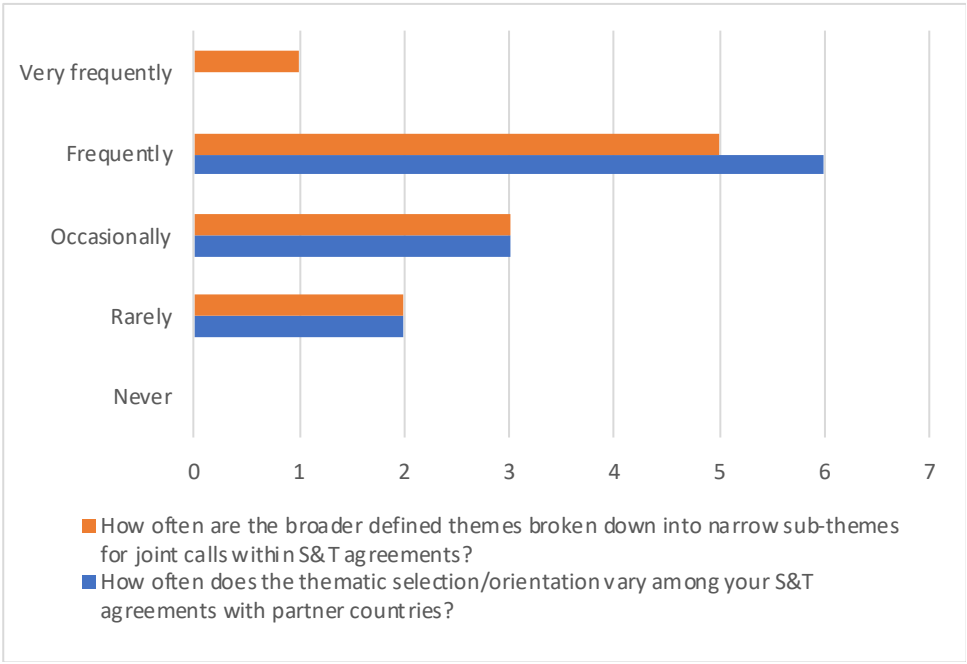
Source: First survey sent to MLE participants; own calculations; n=11

In terms of thematic selection, on the one hand, one can conclude that the fierce quest as to which thematic priorities should be selected seems to have lost momentum, because of the widespread thematic orientation of most of the EU Member States on the global challenges as defined at the European level. On the other hand, many programmes and instruments supporting R&I internationalisation are still designed in a bottom-up manner without any thematic specification or, at least, without strong ones.

ERAWATCH stated back in 2013 that it is difficult to connect the geographical focus to a thematic priority (ERAWATCH, 2013). In addition to thematic openness and/or the orientation towards global challenges, national thematic strengths remain, of course, a core criterion for thematic selection, although these are sometimes combined with a thematic orientation towards Grand Challenges.

The SFIC survey on Tools and Policies in International S&T Cooperation (2018) revealed that many EU Member States/Associated Countries focus their cooperation with third countries on the broad areas of engineering and technology and natural sciences in general. In R&I internationalisation strategies, thematic priorities are often framed either as 'challenges' or as 'technological growth areas', which often imply certain sectors and markets (ERAWATCH, 2013). These broad thematic areas (e.g. energy or health, which are laid down in several S&T agreements) vary depending on the involvement of specific international partner countries (see the blue bar in Figure 5) and are broken down into narrower sub-themes for joint calls within S&T agreements (see also Section 4.4.; orange bar in Figure 5). The European Commission is equally specific in its identification of themes for bilateral cooperation, depending on the country.

Figure 5: Thematic variations between partner countries and calls within S&T agreements



Source: First survey sent to MLE participants; own calculations; n=11 for both dimensions

3.3 Embedding and alignment challenges of international R&I cooperation policies in national R&I strategies

The 'embedding challenge' concerns the embedding of the R&I internationalisation strategy into the overall strategic R&I framework of the country (or region) and the alignment of instruments, programmes and regulations to meet the manifold R&I internationalisation rationales (see section 3.1). In other words, embedding concerns the logical relationship of the R&I internationalisation intervention logic with the overall national R&I strategy and the interlocking of domestic operational policies with internationally oriented ones.

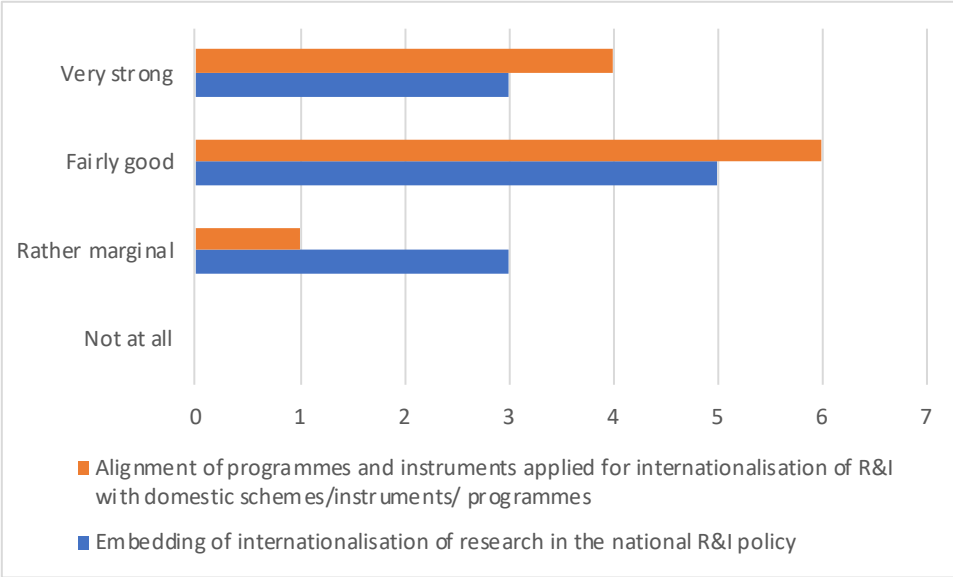
Since targeted R&I internationalisation measures are usually limited in scope and scale (such as international mobility programmes or explicit funding programmes for collaborative international R&I projects), it is beneficial to open up, align and make use of domestic programmes and instruments for international R&I cooperation. This not only creates additional resources for international R&I cooperation but also a more internationalised mind-set in general. The opening-up and alignment can refer to a variety of approaches ranging from domestic excellence-oriented programmes (including research infrastructure) to more applied or industry-related R&I programmes. Due to their often intrinsic cross-border dimension, this is most obvious in the case of programmes and instruments aiming to tackle grand or global challenges. However, this requires the existence of thematic policies and priorities at the national level. While the global challenges seem an obvious starting point to

add value to national R&I strategies and to foster alignment with R&I internationalisation rationales and approaches, a prioritisation of themes within the broad spectrum of SDGs could be a first step to be taken (see also Section 4.1).

The level of embedding the internationalisation of research in the national R&I policy differs significantly among the MLE participants who responded to the first survey (Fig. 6). In general, there is room for further gains. Only Ireland, Slovenia and Turkey reported a very strong embedding. The situation is slightly better as regards the alignment of programmes and instruments applied for the internationalisation of research with domestic schemes, instruments and programmes. Ireland, Norway, Portugal and Turkey reported a very strong alignment in this respect.

ERAWATCH (2013) observed that coordination and alignment are stronger in countries that do have a strategy.

Figure 6: The embedding and alignment of international cooperation in the national R&I policy and domestic schemes, instruments and programmes



Source: First survey sent to MLE participants; own calculations; n=11 for both dimensions

The 'embedding challenge' is intensified by a sometimes observable 'policy distance' between those who develop a strategy and those responsible for designing and implementing the measures. This is a classical principal-agent challenge. The strategic objectives and requirements have to be specific and stringent to have the power to influence and shape the necessary programmes and instruments, but sometimes the available programmatic and instrumental toolbox remains unchanged.

If this is the case, it would be a main rationale and task of an R&I internationalisation strategy (and its 'owners') to influence and shape

structures, programmes, instruments or framework conditions to become more beneficial for international R&I cooperation and/or to provide additional structures, programmes, instruments and incentives (e.g. targeted R&I internationalisation programmes) where the national ones fall short. Norway provides an inspiring example for this (RCN, 2010; see more details on that in Schuch, 2019).

Vinnova, Sweden's innovation agency, also adopted a national internationalisation strategy with the aim of taking into account international perspectives when planning national programmes. A central part of developing this strategy has been the anchoring and involvement of the whole of Vinnova.

Recommendation 2: Reinforce strategic alignment of domestic policies to meet R&I internationalisation rationales

The recommendation is to reinforce strategic alignment of domestic instruments, programmes and regulations to meet the R&I internationalisation rationales stipulated in an R&I internationalisation strategy or roadmap.

Addressee: The national R&I policy-making level responsible for establishing a strategy or roadmap for international R&I cooperation and the designers of specific policies in ministries or agencies (e.g. R&I cooperation programmes, instruments or initiatives).

Within the overall strategy development process, co-development is an approach that helps factor in the integration and the mainstreaming of international R&I cooperation and the removal of barriers from the very beginning. It also provides the right timing to make influential opinion-makers and gate-keepers aware of the importance of the R&I internationalisation agenda and – in the best case – to make them allies. However, since many overall national R&I strategies lack operational implementation details and specific roadmaps, it seems to be beneficial to follow up with a targeted R&I internationalisation strategy which shows a clear intervention logic aligned to the overall national R&I strategy, objectives and intervention areas, instruments, time plan, and includes a budget forecast and a section on monitoring and evaluation.

Germany, France and Austria are examples of countries where the R&I internationalisation strategies were developed as a follow-up to the national R&I strategies, while in other countries, international R&I cooperation was already considered as a dedicated part (usually in the form of a chapter or section) of the national R&I strategy.

Recommendation 3: Co-develop strategies

Although there is no general recipe, the ideal approach is probably to co-develop a strategic R&I internationalisation concept (or 'Leitbild') – based on a clear intervention logic – together with the overall national R&I strategy, and to integrate it there firmly. A second proposed step is to follow up with a dedicated R&I internationalisation roadmap, which builds on the overall national R&I strategy and which further refines it. The recommendation is to include relevant stakeholders in these processes. (Find out more about stakeholder integration in the next section.)

Addressee: The national R&I policy-making level responsible for establishing a strategy or roadmap for international R&I cooperation.

3.4 Securing cross-government and multi-level participation approaches

Given that more and more R&I internationalisation strategies and roadmaps are increasingly opening up to include non-S&T-intrinsic matters (e.g. innovation-related objectives) (see section 3.1), coordination for (a) developing and (b) implementing an R&I internationalisation strategy requires both (i) cross-governmental and (ii) multi-level participation approaches.

With regard to cross-governmental cooperation, the default situation is that usually the ministry(-ies) responsible for science and research, as well as innovation and economy, have elements of R&I internationalisation in their portfolio. They are the main drivers of steering and coordination. Very often the foreign ministry is also called in. Sometimes the ministries responsible for environment, food and agriculture, health, energy, climate, (sustainable) development and defence deal – at least, to a certain extent – with issues of international R&I cooperation (ERAWATCH, 2013). Thus, it is important to carefully screen the distribution of competences and the contributions of the various ministries.

During the development of an R&I internationalisation strategy or roadmap, expectation management becomes a critical issue because stakeholders can have rather opportunistic approaches. Strategy development, however, means focusing on important elements and leaving aside less important ones or those that run by themselves. This can meet with resistance.

The development of an internationalisation strategy or roadmap often involves extensive and timely involvement of stakeholders – through input papers, dialogue formats, online surveys, working groups or other means of consultation.

In addition to governmental entities, R&I funding agencies, research councils, academies of science and representatives of universities and research organisations (e.g. rectors' conference), specialised agencies (such as international-oriented business agencies, development cooperation agencies or space agencies) and social partners (such as the chambers of commerce) should also be invited. In a few cases, large private research funding foundations might also be considered (see also Recommendation 8).

A special challenge is to take on board the views of the beneficiaries for which the R&I internationalisation strategy is actually developed (e.g. researchers from academia and business, higher education institutions, research organisations and companies). Very often this is done via representation bodies (e.g. a rectors' conference, international offices of higher education institutions, or groups that are formed on a bottom-up basis such as science for development associations), but larger surveys to reach out to individuals can also be implemented.

The nature of the coordination changes once a strategy is being implemented. Coordination then becomes more intensive at the operational implementation level (e.g. cooperation with R&I funding agencies). It is advisable to continue the implementation process with a formalised cross-governmental body (which includes core partner ministries) and to implement a routine based on information exchange and coordinated steering, although usually with divided competences. Meetings at regular intervals (e.g. once every six months) are suggested, but sometimes new developments arise between the fixed meeting dates, requiring more frequent exchanges of opinion. It is necessary that one ministry (usually the ministry dealing with science and research) has the authority and capacity to preside over the cross-governmental coordination process in order to keep the process alive. Sometimes other stakeholders, such as R&I councils or major R&I funding agencies, can be invited to the meetings.

During the implementation phase, contact also needs to be secured with the final beneficiaries to exchange information, identify common concerns, gain feedback and discuss starting points for new initiatives. This can be done via internationalisation round-tables, the dissemination of R&I internationalisation newsletters, social media, digital platforms and other means and formats. Involving stakeholders in an early development phase helps to make them feel responsible and committed to bringing an R&I internationalisation strategy to life. Concrete examples of inspiring practices as to how this can be done are provided throughout all three Thematic Reports published under this MLE (Boekholt, 2019; Könnölä, 2019; Schuch, 2019).

Stakeholder engagement in the partner country, however, is almost always considered to be the responsibility of the partner country. MLE participants found Vinnova's approach of establishing joint partnership platforms within 'International Innovation Initiatives' (Triple I) (e.g. in particular with Canada, Brazil and India), which also secure large stakeholder involvement, to be an inspiring example. The engagement structure in Sweden is basically the same for all countries but the partner countries use a range of different structures. Another inspiring example in this respect is the Air Centre[5] coordinated by Portugal. Thirty workshops took place in many different partner countries situated along the Atlantic coast to let the stakeholders define the research agenda during a scientific diplomacy process that lasted two years.

[5] https://aircentre.org/timeline/#

Recommendation 4: Implement effective cross-governmental coordination and multi-level participation processes

Since R&I cooperation is becoming increasingly horizontally connected to other policy fields, effective cross-governmental coordination at the national level is recommended to achieve coherence and impact. Moreover, the recommendation is to organise inclusive multi-level participation processes to capture the specific knowledge and interests of various stakeholders, to identify opportunities for joint approaches and to create synergies both during the development and implementation phases of an R&I internationalisation strategy.

Addressee: The R&I policy-making and delivery level (including funding agencies, RTI councils, etc.).

3.5 Use of European R&I internationalisation policies for joint activities

The countries participating in this MLE emphasised the importance of European structures, programmes and instruments and confirmed that they make use of them for international R&I cooperation. Frequently mentioned in this context was, of course, the European Union's Framework Programme for R&I, but also the Joint Programming Initiatives and international European Research Area Networks (ERA-NETs) targeting specific countries/regions (more details can be found in Schuch, 2019).

On the other hand, the MLE participants also indicated some communication-related challenges and a list of potential EU policies and instruments for R&I internationalisation, which they see as being missing or – if they already exist – should be improved or expanded. Among the perceived needs which directly address international R&I cooperation beyond Europe are the following (an extended list can be found in Schuch, 2019):

- More joint policies together with other EU Member States and associated countries, which support the visibility of Europe and its capacity to act in international R&I cooperation
- More explicit measures for international R&I cooperation in the European Union's Framework Programmes for R&I
- More targeted activities for R&I internationalisation, e.g. through open calls or in flagship initiatives
- Mechanisms to increase the participation levels of EU neighbourhood countries in COST
- Stronger science-diplomacy activities at the European level
- Stronger involvement of EU Member States in the development of the European Commission's multiannual roadmaps with partner countries/ regions.

The challenges discussed can be divided into three main clusters:

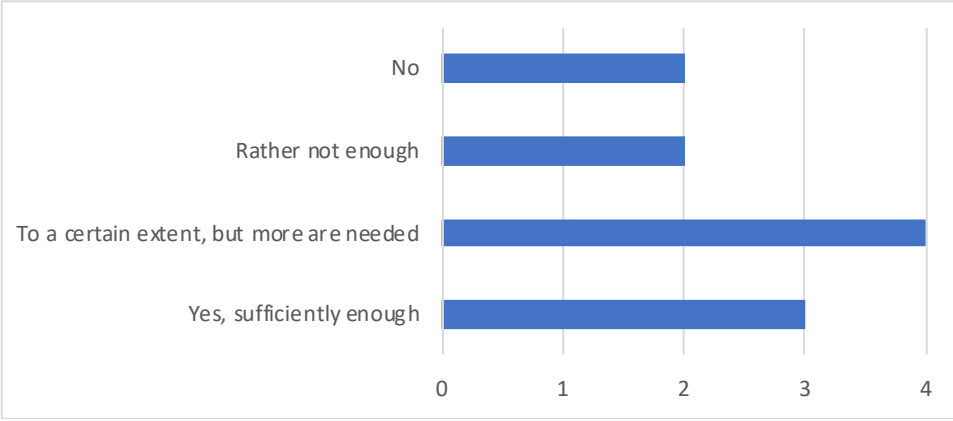
1. Procedural complexity, e.g. complex communication, information asymmetries and cumbersome bureaucratic procedures (e.g. short-term notifications; insufficient time for consultation; insufficient follow-up coordination – e.g. in relation to SOM or high-level dialogues with third country groupings) were most often indicated

2. A stronger focus on international R&I cooperation within the existing European instruments

3. The facilitation of joint activities between EU Member States/Associated Countries with specific international partner countries or regions.

A particular problem relates to the lack of resources at the level of EU Member States/Associated Countries (see Figure 7). This is especially true for preparing and implementing multilateral efforts, which, however, will increasingly gain importance according to the MLE participants. They also confirmed that coordinated approaches within the EU, to establish synergies and to create critical mass in international R&I cooperation activities towards certain regions or countries, could be stepped up and be more effective. Taking part in common international initiatives *is complex and leaves less latitude for national steering. But it makes international knowledge production available to participants on a scale that would otherwise be unobtainable* (RCN, 2010, p. 5). However, smaller countries in particular are more often confronted with capacity shortages that prevent them from playing an intensive part in international initiatives.

Figure 7: Availability of resources to coordinate strategic activities with external partners and initiatives



Source: Survey sent to MLE participants; own calculations; n=11

Only three countries replied that they have enough human resources and/or travel budgets available to coordinate their strategic activities with external partners or initiatives in the field of research internationalisation (see Figure 7, above). Four countries replied that resources are to some extent available, but more is needed. Two countries have not enough resources and two more

definitely too little. This can be considered as a severe structural problem. The MLE participants claimed that the potential to create added value through joint multilateral activities is not sufficiently tapped and that this situation cannot be improved without support from the Framework Programme to cover coordination costs.

Recommendation 5: Secure sufficient resources for multilateral R&I coordination and internationalisation activities

Since multilateral coordination and cooperation for and within international R&I initiatives with other EU Member States, Associated Countries and external partners is becoming more and more common, sufficient resources need to be allocated for this at the national level.

Especially in the face of upcoming areas of action such as challenge-driven international R&I cooperation, coordination between European countries is of utmost importance for a coordinated appearance at the global level. This should be strongly aligned with the European Commission and adequately supported by European policies.

Addressee: The R&I policy-making and delivery level (including funding agencies, RTI councils, etc.).

3.6 Monitoring and evaluation

As for any other public intervention, it is important to check the progress of the implementation of R&I internationalisation and to identify and assess the results which can be attributed to it. However, continuous collection of R&I internationalisation data for monitoring purposes, especially beyond Europe, is very rare and evaluations in the field are only implemented occasionally (Boekholt, 2019; Schuch, 2019).

Edler and Flanagan (2009) identify needs for indicators at four stages:

1. There is a need for indicators of the 'status quo', to describe and assess the current internationalisation of the R&I system under investigation. This is usually done *ex ante*, e.g. before an R&I internationalisation strategy or roadmap is developed and adopted.

2. Indicators are then needed to set targets and to make choices. The definition of a desirable scale and scope of activities is a key challenge, because more internationalisation, *per se*, is not necessarily better.

3. Further indicators are necessary to understand the international 'opportunity environment'. Good intelligence regarding potential international partners is vital, but only a few systematic indicator systems are in place. Top-down prioritisation is done according to broad political criteria, while bottom-up activities are largely driven by personal knowledge and networks.

4. Finally, there is a need for indicators for monitoring and evaluation to scrutinise whether important initiatives, programmes and instruments work in the way they were designed. Such an evaluation of individual programmes and instruments, or portfolios of programmes and instruments, is carried out to verify their relevance, effects (outputs and results) and – if possible – impacts.

Embedding indicators, and indicators at the system level, are the most relevant indicators for the assessment of the *status quo* of R&I system internationalisation in a specific country or region (Schuch, 2019).[6] While these indicators usually target a higher level of aggregation to describe and assess a certain situation or *status quo*, most of them have limited use for measuring the impact in terms of, for example, lasting networks, knowledge and innovation-related results, dissemination of knowledge or contributions to environmental and societal challenges (Fikkers and Horvat, 2014; Gnamus 2009).

To track the results of policy interventions, clear intervention logics (e.g. based on a Theory of Change) need to be developed as a starting point for the evaluation (see Recommendation 1). The lack of good data on the results of international collaboration can largely be explained by the very general objectives attached to international R&I cooperation programmes, mobility schemes and other support activities. Being more explicit about the expected success and targets of these support activities would allow a better assessment of outcomes (Boekholt, 2019).

Attribution problems – such as the logical and *de facto* connection between inputs (e.g. resources assigned to certain interventions), outputs, results (or outcomes) and impacts – remain an issue. While outputs can relatively easily be attributed to certain activities that are triggered (and usually also funded) through policy interventions, outcomes (e.g. the direct effects on the intended target groups) and especially impacts (e.g. the longer-term effects on the final beneficiary groups or systems not directly targeted by an intervention) are very difficult to grasp and assess.

There are no 'one-size-fits-all' indicators and no 'one-size-fits-all' methodological recipes. Different indicators are needed for different considerations. Thus, specific indicators need to be constructed, using metrics that are universal, precise, unambiguous and relevant. Unfortunately, the number of evaluations of international R&I cooperation interventions is still so limited that, for the time being, a robust stock of knowledge about the adequacy (e.g. relevance, reliability and validity) of the indicators used is lacking.

Even more difficult than the identification of adequate indicators, impact-related or not, is the issue of data availability. Often R&I internationalisation data are uneven and have limited comparability. For comparative bibliometric-based

[6] Extensive lists of indicators have been compiled by Brandenburg and Federkeil (2007) for measuring the internationality and internationalisation of higher education institutions and by Schuch (2011) for measuring the internationalisation of science and research.

analysis, a certain dependency on commercial data providers (e.g. SCOPUS or Web of Science) can be ascertained. Given the often limited availability of monitoring data and secondary data on R&I internationalisation, surveys are still needed (for instance, to evaluate certain [portfolios of] programmes and instruments). They are costly and often only one-off projects, even though they should be repeatedly implemented for monitoring purposes, e.g. to assess the progress in R&I internationalisation.

The monitoring and evaluation of international R&I cooperation are further impeded by a lack of sufficiently good practices and standards. This starts with a shortage of guidelines as to how to formulate clear intervention logics and objectives for specific purposes (complemented by practical examples) in order to understand what success means so that the progress and effectiveness of international R&I cooperation interventions can be better monitored and evaluated. Such an exercise should obviously start with the most common policy interventions in international R&I cooperation, including collaborative activities as part of an STI agreement.

Based on this, guidelines for a systematic monitoring of international R&I cooperation in order to follow up progress and enable comparison of the results over time should be developed. Existing national monitoring systems should be taken into account and interconnected on a modular basis into current national research information systems (CRIS).

Ideally, national R&D surveys, which are regularly carried out by the national statistics offices in each EU country, should also be expanded to capture international cooperation in R&I. The focus here should be on suggesting a limited number of meaningful indicators to assess the relevance, effectiveness and impact of R&I internationalisation.

A further approach would be to launch a pilot survey at the European level or at least by a couple of EU Member States and Associated Countries (variable geometry), using jointly agreed indicators and methodologies to assess the impact of national and European R&I internationalisation activities. Due to their 'beyond academic impact' orientation, challenge-driven international R&I cooperation activities could be taken as a starting point.

The suggested work on establishing guidelines, jointly co-creating indicators and co-designing monitoring and evaluation standards, as well as testing of results-oriented indicators through a jointly launched pilot survey, could be considered by SFIC (see Recommendation 13) and commissioned to experts, perhaps with support from the European Commission. Such aligned efforts would also increase comparability between countries, which would help in identifying inspiring practices and in setting target values and benchmarks.

Recommendation 6: Monitor and evaluate international R&I cooperation policies

The recommendation is to jointly develop monitoring and evaluation standards in order to facilitate the assessment and comparability of international R&I cooperation activities.

The joint monitoring and evaluation standards should focus on:

- Drafting meaningful guidelines as to how to formulate a clear intervention logic and objectives for specific purposes to understand what success means (see also Recommendation 1)
- The development of guidelines for systematically monitoring international R&D cooperation to follow up progress and to enable comparison of results over time
- The elaboration of a proposal for supplementing the national R&D surveys with a few meaningful indicators to assess the relevance, effectiveness and impact of R&I internationalisation
- The preparation of a pilot survey at the European level or at least by a couple of EU Member States and Associated Countries (variable geometry) to assess the impact of national and European R&I internationalisation activities.

Addressee: SFIC or a group of European countries on the basis of variable geometry.

4 Upcoming challenges and developments

Whereas chapter 3 revisited the current state of the art in international R&I cooperation policies, chapter 4 deals with upcoming challenges and developments. Special emphasis was put on how to work with SDGs for challenge-driven international R&I cooperation. This discussion also highlighted the importance of multilateral approaches and the development of multi-stakeholder partnerships for challenge-driven international R&I cooperation. There were exchanges of opinion on the framing and scoping of science diplomacy in general, and specifically the additional value of intergovernmental Science and Technology Agreements and Memoranda of Understanding (MoUs), as well as the anchoring of 'good cooperation' principles under such agreements and MoUs. Geopolitical developments, the global biosphere and social challenges put further pressure on efforts to remain agile in the context of international R&I cooperation. Thus, approaches for anticipating the future but also for shaping options for the future in terms of frameworks for international cooperation in R&I were discussed. The need for coordinated multilateral approaches was repeatedly affirmed.

4.1 SDGs in international R&I cooperation: from recognition to joint action

By challenge-driven international R&I cooperation we refer to international cooperation processes and practices to solve shared challenges, of which today the most widely recognised reference framework is the Sustainable Development Goals (SDG) of the United Nations.[7] From a transformative R&I policy point of view, three types of SDGs can be distinguished (Schot et al., 2018): i) SDGs which cover specific or a wider range of socio-technical systems or application areas; ii) SDGs which emphasise 'transversal directions' or directionality and iii) SDGs which focus on structural transformation in framework conditions (Figure 8).

To better leverage the national potentials and to create stronger contributions to solving grand (or global) challenges, countries address challenge-driven international R&I cooperation more explicitly by referring to the substance of the SDGs to which they committed themselves at the UN level in 2015.

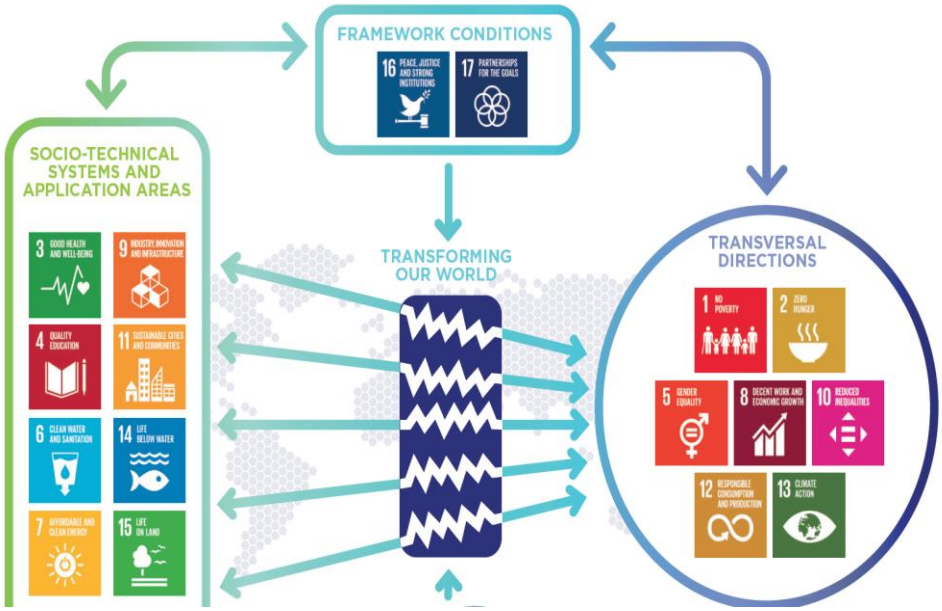
Challenge-driven R&I at the EU level, in particular, is influenced by the UN Agenda 2030 and the SDGs.[8] In the Multiannual Financial Framework (MFF) draft text,[9] there is a close link between international R&I cooperation and the SDGs. The European Green Deal of the current European Commission (2019a, 2019b), an ambitious package of measures that should enable European citizens and businesses to benefit from a sustainable green transition, as well as the thematic clusters and missions approach in the forthcoming Horizon Europe programme, are prominent direct responses to the UN Agenda 2030.

[7] https://sustainabledevelopment.un.org

[8] https://ec.europa.eu/environment/sustainable-development/SDGs/implementation/index_en.htm

[9] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52018PC0435&from=EN

Figure 8: Three types of SDG areas and transformations (Modified from Schot *et al.*, 2018)



Thematically, the SDGs[10] are addressed at the European level in the second pillar of Horizon Europe in particular, with six focus clusters. Each cluster contributes to several SDGs, and many SDGs are supported by more than one cluster (Mayer and Schuch, 2019). The SDGs are also the starting point and reference framework for the mission-oriented approach in Horizon Europe. The purpose of a mission is to deliver concrete results for society and to create a European public good. Missions should be well-defined and self-standing programme parts, as opposed to the focus areas which are 'virtually linked calls' within the Horizon 2020 programme structure.

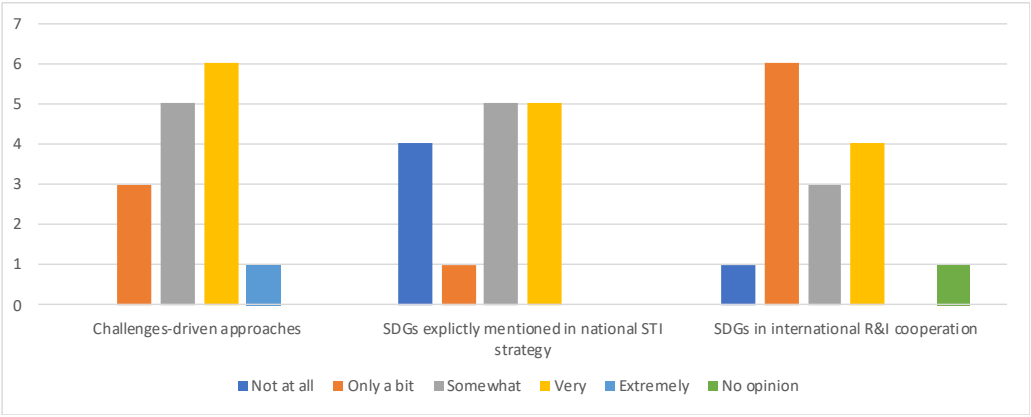
EU institutions and agencies have also taken up challenge-driven approaches, such as the European Environment Agency (2016), the EIT Climate-KIC or the Joint Research Centre, which identified links between Smart Specialisation and the SDGs (find more information on the take-up of SDGs at the European level in Könnölä, 2019).

Several EU Member States and countries associated to Horizon 2020 consider Horizon Europe as key to the implementation of the SDGs. Germany emphasised that *stronger ties between FP9 and the R&I related aspects of the SDGs would also highlight the serious ambition to link national, European and international processes more closely than in the past* (Mayer and Schuch, 2019, p. 31).

[10] Within the rationale of the MFF, research and innovation activities in Horizon Europe are subsumed under 'single market, innovation and digital' with no direct reference made to the SDGs. The SDGs are not mentioned in Pillar 1 about the ERC and the MSCA or in Pillar 3 (Mayer and Schuch, 2019).

A discussion emerged in this MLE about how to deal with challenge-driven approaches and, in particular, how to frame SDGs in this respect. The MLE participants noted that challenge-driven approaches can complement thematically open approaches and that there is no stringent need to predefine how the challenges will be addressed (e.g. by prescribing disciplines or R&D activities). Even though the responses were strongly defined by the specific role and function of the responding MLE participants, challenge-driven approaches seem to be commonly considered, albeit not prioritised, in the R&I strategies and policies for international cooperation of the participating MLE countries (see also section 3.1). The level of integration of SDGs varies, though, (see Figure 9) and most countries have not yet operationalised SDGs until now.

Figure 9: Integration of challenges in the practices of funding organisations



Source: Third survey sent to MLE participants October/November 2019; n=15

Strategies established before 2015 (the year when the SDGs were launched) do of course not refer to SDGs. Ireland's national R&I strategy 'Innovation 2020' is an example of a strategy predating the SDGs. Nevertheless, Ireland's research prioritisation, which aligns the majority of competitively awarded public investment in research with 14 priority areas, was revisited in 2018 and the priority areas have been revised to reflect the SDGs.[11] Another case is Austria, whose STI strategy was published in 2011, shortly followed up by its international R&I strategy (Austrian Federal Ministry of Science et al., 2013). It is expected that both the SDGs and the challenge-driven approach will gain more prominence in Austria's forthcoming STI strategy. In Sweden, societal challenges and SDGs are government priorities and they are foreseen to play an important role in the coming years.

Specific instruments for challenge-driven funding have been developed in some countries, but only a few are deliberately oriented towards international R&I cooperation (for more information on that, see Könnölä, 2019). A specific issue

[11] https://dbei.gov.ie/en/Publications/Publication-files/Research-Priority-Areas-2018-to-2023.pdf

in designing challenge-driven R&I cooperation policies is to identify suitable thematic priorities, and subsequent R&I topics, that fit the needs of both the policy-makers' own country and the international partner country. According to the MLE participants, governments often establish horizontal coordination mechanisms to address SDGs at the national level. Thematic coordination with international partner countries, however, occurs only exceptionally.

Most of the MLE participants identified several thematic SDG areas that are particularly highlighted within national and international R&I cooperation. Energy and health were most often mentioned. In other areas, the views varied considerably, indicating different thematic priorities. In Romania, for instance, the emphasis was on clean water, sanitation and education, while in France environment and climate change occupied a strong position. SDGs are not always specifically referred to but an *ex post* assignment between programme themes and SDGs can be established, for instance, in areas like food, water, agriculture, energy, environment and ICT (for more information on this, see Könnölä, 2019). For the time being, some MLE participants assign SDGs and challenge-driven R&I to the European level rather than the national one. This might be caused by the inclusive character of the SDGs, which may lead to the assumption that an international approach is easier to accomplish at the EU level than at the national level (Gustafsson, 2019). The MLE meeting participants considered multilateral agreements to be the most difficult ones to establish (see also Recommendation 13).

MLE participants also found it difficult to define impact indicators for SDGs. Some use indicators of 'Distance towards the goals', for instance, but it would be helpful to develop systematic mechanisms as to how to monitor achievements towards challenges, in particular in relation to SDGs (see also Recommendation 6).

Recommendation 7: Promote SDGs and challenge-driven R&I in international R&I cooperation

To better leverage the national potential and to create stronger contributions to solving grand (or global) challenges with international outreach, countries should continue their work on addressing and strengthening challenge-driven international R&I cooperation more explicitly by referring to the substance of the SDGs to which they committed themselves at the UN level in 2015. Thus, SDGs should increasingly be taken as a starting point for joint agenda setting in challenge-driven international R&I cooperation. To exploit synergies and engage more in international multilateral challenge-driven R&I cooperation, joint approaches should be co-designed by EU Member States and countries associated to the Framework Programmes on a voluntary basis. Lessons can be learned from previous co-programming efforts such as in the Joint Programming Initiatives (JPIs).[12]

Addressee: The national R&I policy-making level responsible for establishing a strategy or roadmap for international R&I cooperation and the designers of specific policies (e.g. R&I cooperation programmes, instruments or initiatives).

[12] The findings of ERA-Learn can be exploited for this: https://www.era-learn.eu/

4.2 Multi-stakeholder funding partnerships for challenge-driven international R&I cooperation

Cross-sectoral coordination is increasingly developing in international R&I cooperation, primarily at inter-ministerial level. Cooperation between the ministry(-ies) responsible for science and research and the ministries responsible for economic affairs and innovation and for foreign affairs is already common practice. The MLE participants also considered demonstrating the benefits to other (sectoral) ministries and creating personal networks between the staff of these ministries and agencies as being useful for promoting horizontal cooperation; although the incentives and resources to mobilise this type of cooperation and support are not always available. Cooperation is very much a people's business and existing examples demonstrate that it is very rewarding for the policy-makers involved when it works well.

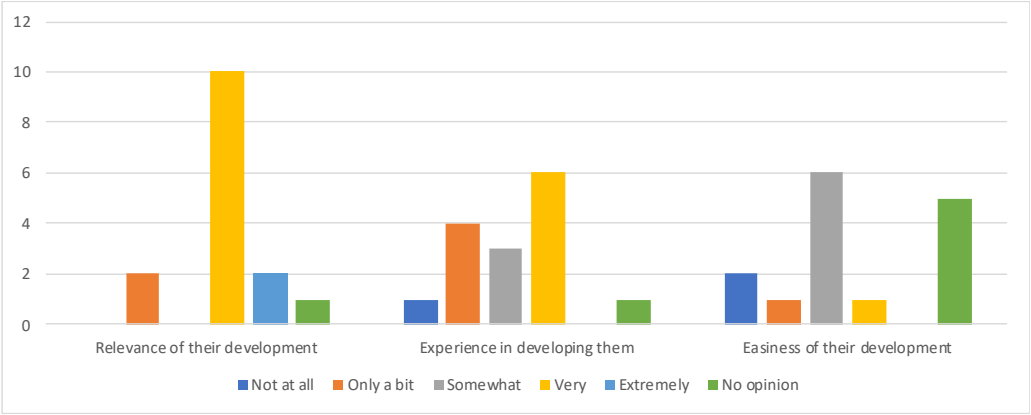
Information sharing was considered as an essential first step. The reluctance, however, to allocate sectoral R&I budgets for certain activities was considered a challenge. Thus, MLE participants confirmed that it is probably more advisable to focus on aspects of joint strategic considerations for international R&I cooperation before issues of funding allocation are discussed. Otherwise the inter-ministerial or inter-agency discussions run the risk of being only about allocating funding, even if ample budgets are made available (Könnölä, 2019).

An inspiring practice for inter-agency collaboration in the field of international R&I cooperation is the Swedish Intsam initiative. Intsam is an inter-agency working group set up by Swedish research funding bodies (the Swedish Research Council, Vinnova, Forte, Formas, the Swedish National Space Agency and the Swedish Energy Agency) to coordinate Sweden's international cooperation outside the EU. It started with a small additional budget to help the Swedish agencies, which have different R&I support functions, work together. The agencies could decide themselves on how to organise Intsam. Under the umbrella of Intsam, inter-agency working groups mostly focus on specific international partner countries, while two have a multilateral focus (e.g. the Belmont Working Group and the Africa Working Group). Multilateral cooperation is often done via EU activities (e.g. by using JPIs), which is handled under the EU-Sam initiative. Similar to Intsam, the EU-Sam working group coordinates issues relating to the EU's framework programme, and the 'partnership programmes'. Both the Intsam and EU-Sam secretariats are located at Vinnova. Representatives from relevant ministries normally participate in the meetings.

Multi-stakeholder partnerships, however, can also be built with private partners, which seem to be increasingly responsive to challenge-driven R&I and SDGs. Most obvious is the engagement of private philanthropic institutions. A very visible example is the Bill and Melinda Gates Foundation, proactive in public health in developing countries, creating public-private partnerships with governments (the traditional candidates are Canada, Sweden and Switzerland, but also Brazil and India) and big firms, to orchestrate their work (Kuhlmann and Rip, 2018). The government role could be to offer legitimacy. Governments could also ensure that there is a regular reflection on the nature of challenges and the role of various actors (and ensure a link with democratic decision-making) (Kuhlmann and Rip, 2018).

Most of the MLE participants found multi-stakeholder funding partnerships with private and third sector entities relevant, but not that many considered that their country was experienced in developing them. Such differences may derive from the shared perception of how difficult it is to develop such partnerships (see Figure 10).

Figure 10: Multi-stakeholder funding partnerships with private and third sector entities



Source: Third survey sent to MLE participants October/November 2019; n=15

Based on experience, for instance in Sweden, philanthropic organisations are very interested in working together with governments. Sweden has large foundations and Swedish public R&I funding organisations are already collaborating with them to generate greater impact in their collaborations with third countries. If the foundations consider this as beneficial to their own goals, then cooperation is usually considered feasible.

The MLE participants noted that it would be good to have partnerships with companies for SDGs in the EU (as in the USA). The Global Forum on SDGs was referenced as inspiration, which is based on enterprises focusing on thematic value chains. Another way to do this can be via Important Projects of Common European Interest (IPCEI)[13] in the new industry policy (focused on strategic value chains). Where private initiatives fail to materialise because of the significant risks and transnational cooperation, IPCEIs offer a mechanism for Member States to fill the funding gap in order to overcome such market failures and boost the implementation of projects that otherwise would not be carried out.

International mapping of good practices, in particular in the USA and Europe, could provide important learning opportunities for the Member States. Especially in the USA, but to some extent also in the UK and Northern Europe, some companies and private foundations engage in challenge-driven

[13] https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1517560605813&uri=OJ:JOC_2018_039_R_0003

approaches involving R&I, together with public partners. Cooperation with them could provide not only further resources but also opportunities for mutual learning and the exploitation of synergies along a societal value-added chain which addresses jointly defined grand (or global) challenges. Such mapping could also benefit from background work by the European Commission in considering further cooperation with philanthropic organisations in Horizon Europe.

Recommendation 8: Explore multi-stakeholder funding with private and third sector entities

International mapping and further networking among initiatives and learning platforms is needed to enhance practices of multi-stakeholder funding. In connection with existing initiatives, a dedicated Task Force should be formed/set-up to explore under which conditions such multi-stakeholder partnerships with private and third sector entities could be established and which EU Member States and countries associated to the Framework Programme would be willing to engage in such identification and co-development processes.

Addressee: SFIC or a group of European countries on the basis of variable geometry.

4.3 Enhanced valorisation and operationalisation of science diplomacy

Science diplomacy is usually applied to facilitate external/foreign policy (Royal Society and AAS, 2010; Gluckman et al., 2017). Although frequently mentioned, the specific role and contribution of R&I internationalisation strategies and policies to science diplomacy often remains very vague. Science diplomacy subsumes issues such as building scientific bridges in times of conflict, providing collaborative resource management for our planet, working on common standards (e.g. for market access and trade) or simply taking care of – mostly historical and geographical – cultural, political or socio-economic ties between countries. Sometimes the sheer existence of R&I internationalisation instruments is regarded as a contribution to science diplomacy although their relevance for and uptake by foreign policy is far from clear.

Sometimes science diplomacy is also linked to development cooperation, with increasing intention to go beyond traditional science for development projects. Here, increasing focus is on the establishment of sustainable STI partnerships dealing with capacity development and institution-building (e.g. support in establishing joint R&D infrastructure, funding agencies or RTI councils, or support in drafting laws). These rather structural approaches should help partner countries to develop into knowledge societies and at the same time contribute to the development of a lasting relationship, which is expected to be mutually beneficial in the longer term (AWTI, 2017).

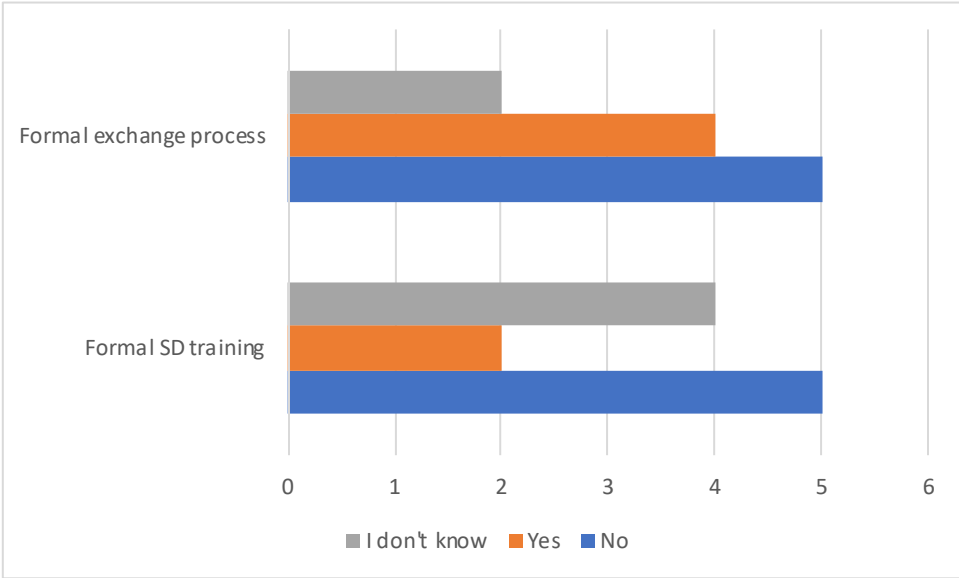
The United Kingdom has two funds focusing (mainly) on encouraging this relationship: 1) the Newton Fund (2014-2021; £735 million), which supports science and innovation partnerships in order to foster economic growth and social development in partner countries, promoting the United Kingdom and

creating opportunities for business; 2) the Global Challenge Research Fund (2015-2019; £1.5 billion), which has the mission of finding British solutions to social challenges in developing countries. In Germany, the German Federal Ministry of Education and Research (BMBF) has drawn up an Africa Strategy (2014-2018; €300 million) in which the central focus is on common research and educational cooperation. This has, for example, led to the formation of the African-German Network of Excellence of Science. The European Commission links development cooperation to STI within the European Development Fund for 'Knowledge for Development' with a budget of €35 million (all information taken from AWTI, 2017).

According to the survey sent to the countries participating in this MLE, this advanced approach is partly applied by France, Moldova, Portugal and Turkey (see Schuch 2019 for further information). Six countries, however, are not engaged in such exercises with their international partner countries.

The unclear role of science diplomacy in international R&I cooperation might also be exacerbated by the fact that the ministries for foreign affairs and the ministries responsible for international R&I cooperation policies are often only loosely connected (see Fig. 11). Formalised exchange processes on science diplomacy issues between the ministries of foreign affairs and the ministries responsible for R&I (see Fig. 11) only take place in four countries participating in this MLE. The majority of countries do not have these formalised exchange processes. Moreover, only diplomats in Austria and France are formally trained in science diplomacy. Interestingly, four respondents did not know whether or not formal science diplomacy training exists in their country, which confirms that action spaces are still rather distant from each other (Figure 11).

Figure 11: Formal science diplomacy (SD) training and formal exchange process between the ministries engaged in R&I and the foreign ministry to consult regularly (not just *ad hoc*) on SD issues



Source: Survey sent to MLE participants; n=11

The following questions might serve as inspiration to re-define the joint responsibility for science diplomacy between the foreign ministry and the ministry(-ies) in charge of international R&I cooperation:

- How is the take-up of international R&I activities (e.g. in the field of joint R&I projects or mobility) by foreign policy and what could be done so that the take-up and use of R&I, in particular international R&I, by foreign policy, is increased?

- Are the available R&I internationalisation measures conducive to serving the needs of foreign policy? Are particular measures missing in R&I internationalisation strategies that serve probably more intrinsic needs of foreign policy (e.g. in the field of arms proliferation; security research; trafficking; migration; cross-border environmental issues; human rights; governance issues [e.g. space], SDG-related topics, etc.)?

- Beyond the funding of international mobility and research projects, are there tools available that enable structural peer-to-peer cooperation and knowledge transfer at policy level with international partner countries (e.g. priority countries in development cooperation) in terms of capacity development and institution building in the field of R&I policy?

- Are the objectives of R&I internationalisation strategies, such as the Excellence, Global Challenges or the Nation Branding Objective, effectively promoted and supported by foreign policy and its related institutions (e.g. embassies) and what needs to be done to make them more effective?

- Are diplomats sufficiently informed and trained (beyond their own personal higher education experiences) on how national systems of research and innovation function?

- Are regular and formalised exchange formats between the foreign ministry and the ministry(-ies) in charge of international R&I cooperation available to reduce information asymmetries, to increase mutual understanding and to explore joint activities?

A more explicit rationale and agenda-setting process for science diplomacy would help strengthen its role in international R&I cooperation policy. Otherwise, the leading role in setting the agenda as to what science diplomacy does or should do remains mostly with the Ministry of Foreign Affairs. This could have negative consequences for the 'science' dimension in science diplomacy in terms of missed (potential) contributions of R&I internationalisation policy to science diplomacy ('science for diplomacy' and 'science in diplomacy' approaches) as well as less effective support of foreign diplomacy to take international R&I cooperation forward ('diplomacy for science' approach).

A more explicit rationale and agenda-setting process for science diplomacy would help strengthen its role in international R&I cooperation policy. At the national level, cross-ministerial coordination should be strengthened to enhance the valorisation and operationalisation of science diplomacy for enhanced effectiveness. A concrete step to facilitate a more effective use of science diplomacy could be to offer training for prospective diplomats to better understand the various intersections of science, research and innovation and foreign affairs.[14]

Addressee: Member States, especially ministries for foreign affairs and ministries responsible for international R&I cooperation.

4.4 Upgrading the strategic functions of international STI agreements

STI agreements represent one of the most frequently used policy tools in the wider R&I cooperation toolbox in all European countries. As the SFIC Working Group Report (2018) on Tools for STI Cooperation noted, they frequently constitute important mechanisms for promoting and facilitating international cooperation, often by forming legal bases and platforms for further cooperation.[15] Their formal and legal arrangement varies. Mostly they are bilateral; often intergovernmental but increasingly also on the basis of Memoranda of Understanding (MoUs) between similar or different types of legal entities (e.g. agencies and ministries). Multilateral agreements involving two or more European countries are rare.

While some countries connect the bilateral agreement with existing funding and policy programmes, others have funding dedicated to a specific STI agreement. Many others have no *ex ante* budget earmarked to implement the agreement. In many cases the official agreement is only the general framework, which needs an annual or multiannual programme or sets of calls that need to be elaborated and budgeted by the implementing agencies.

It seems that a well-functioning pattern is one where a high-level 'umbrella' agreement that is quite general (often for a period of three to five years) is combined with active implementation mechanisms that can adapt the focus of cooperation in a more flexible manner on a yearly or *ad hoc* basis. The challenge here is how to get the implementing bodies (most often agencies) motivated to keep the cooperation active.

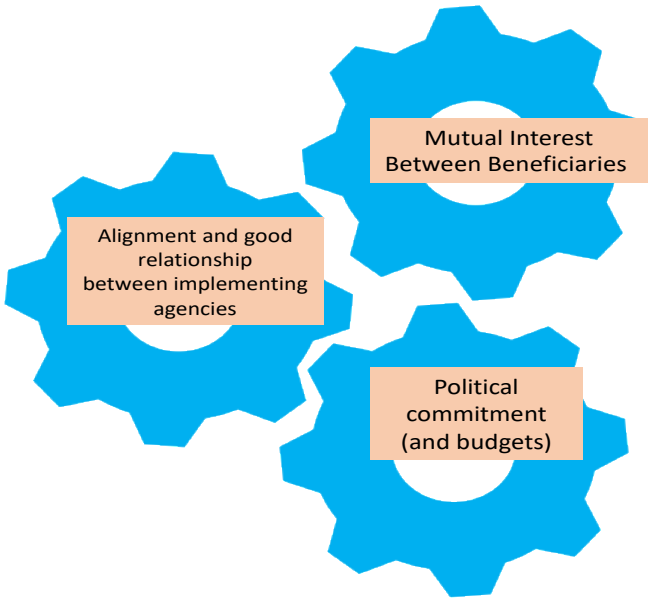
The literature on STI agreements is mostly focused on providing an overview on the types of STI agreements and their use in international cooperation by European Member and Associated States (Fikkers and Horvat, 2014; Vullings et al. 2012; EUROHORCS, 2009; Boekholt et al. 2009). Especially Fikkers and

[14] More information on the actual needs are recorded in Degelsegger et al. (2019).

[15] SFIC Working Group, (2018), Overview of Tools for International Research Cooperation in Science and Technology Matters, Brussels.

Horvat do not find the overall landscape of STI agreements very promising in terms of their effectiveness.

Figure 12: The three 'gears' of successful STI agreements



There is no indication from the MLE debates, however, that STI agreements are an instrument of the past. On the contrary, the sample of successful and unsuccessful STI agreement cases compiled during this MLE exercise shows that there are quite a number of well-functioning and strong STI agreements in place (see Boekholt, 2019, for a full account about successful and unsuccessful STI agreements). There are clear signals that their numbers have exploded and the administrative burden to maintain all of them is becoming a problem for many countries, particularly the smaller ones with limited human resources. Agreements signed with the ambition of accomplishing science diplomacy could increase their number, specifically with countries outside the core group of partner countries that have been targeted for many years.

Critical success factors behind the agreements are the following (in order of importance):

1. Mutual interests of the beneficiaries in the thematic areas of cooperation

2. The relationship and alignment between the implementing agencies

3. Political commitment (and budgets) to support the cooperation (see Figure 12, above).

More detailed information about the success factors can be found in Boekholt (2019).

However, success often depends on its definition, the function of the STI agreement and its implementation tools. Unfortunately, agreements often lack clearly stated objectives or targets, making it difficult to conclude whether they have been a success or not (see also Recommendation 1).

The main reasons why an STI agreement was not a success can be divided into three levels (in order of importance):

1. **Politics and high-level policy**. The discussions with MLE participants provided examples of STI agreements that were signed for mostly political reasons (e.g. prime ministers of two countries keen to collaborate more) or part of high-level policy arrangements (e.g. ministers of two countries negotiating a diplomatic treaty in which the STI agreement is only one element). The most frequently mentioned reason behind a failure was that the agreement was signed for **diplomatic reasons only**, often done too quickly and with no clear idea what the collaboration was meant to achieve. In two cases, with too many national policy stakeholders involved, the agreement became a broad wish list with no owner to ensure subsequent follow-up. In one case, it was stated that there was no intention to follow it up from its very inception. In a few other cases a shift in the political priorities on the partner side, an unstable political environment or the lack of budgets for cooperation prevented the agreement from becoming operational.

2. **Implementation.** In some of the unsuccessful cases, governance and management were agreed upon, implementation mechanisms defined, but they were simply not made active. These are the so-called 'empty shell' agreements. The reasons were lack of human resources, changing political situations, a failure to meet budget requirements in final negotiations and lack of interest from the R&I community. The large majority of failed cases do not have a joint management team or committee and no budgets are foreseen to implement the agreement. In these cases, the STI agreement never got beyond the signing of papers.

3. **Lack of demand for cooperation.** In a majority of unsuccessful cases the agreement had no visibility in the research and innovation community, which was sometimes connected to there being little interest in the thematic areas. One case mentioned that stakeholders from the R&I community were not involved in the process and, more than once, it was stated that the research capacities in the partner countries were low. A few cases went through the process of launching calls but came to the conclusion that there was insufficient response from the R&I community, resulting in the submission of insufficient eligible proposals.

Another noted difference is that in successful cases the objectives were often elaborated in more operational terms than in the unsuccessful ones.

Interestingly, geography does not make a big difference and one can have successful and unsuccessful experiences even with the same country (Boekholt, 2019).

Most of the failing STI agreements were indeed 'empty shells' that remained dormant for a certain period. In the discussion it emerged that these were considered as less problematic than often perceived and, instead of risking diplomatic damage, the 'sleeping beauty' approach – i.e. let them sleep and wake them up if needed – could be more appropriate. Nevertheless, governments should be aware of the negative aspects of keeping too many 'empty shells' alive and should minimise the burden for their administrators (often agencies) in terms of having to continue to renew them.

Although the existence of empty shells cannot be avoided, several provisions can be made to keep STI agreements effective. The MLE clearly showed that an important driver for successful STI collaboration is a strong mutual interest from the research and innovation communities in the partner countries. Stakeholder engagement has been shown to be helpful in assessing which collaborations are already taking place, in gaining a better understanding about which topics the research and innovation communities are interested in collaborating in and, finally, in regularly refreshing the understanding of this mutual interest, as this can change over time.

Moreover, for good STI collaboration, appropriate formal arrangements between the partner countries is not a sufficient condition for success. Building trust in the professional relationships between the counterparts that are responsible for the implementation of an agreement contributes to improving the effectiveness of the collaboration. Regular communication between the partner organisations is a prerequisite for building this trust.

An example of an intergovernmental multilateral STI agreement with long-standing success in terms of building trust between multiple countries is CYTED, the Ibero-American collaborative programme for science and technology for development.

The future of STI agreements was discussed in the MLE workshop in Bucharest. Key outcomes of that discussion were:

- While new and more flexible ways to arrange international agreements are intensively pursued, the signing of 'classic' intergovernmental STI agreements is still considered as politically important. There was little expectation that the portfolio of national STI agreements would be streamlined or reduced in a significant way in the future.

- It was signalled that more can be done in the cooperation between Member States and Associated Countries to launch multilateral STI agreements with third countries (see Recommendation 13). The use of schemes under the EUREKA umbrella was mentioned as a possible way forward, but there is clearly also a need for new platforms and instruments to take action on this.

- The roles of innovation and the economic objectives in STI agreements are clearly rising. A possible danger could be that this becomes a trajectory separate from scientific cooperation and leading to even more R&I agreements.

- Given that new partnerships are mostly with less R&D intensive countries, in the future more flexible agreements or MoUs, which can be easily adapted if priorities change, are more likely to be used.

Recommendation 10: Invest in relationship management and stakeholder engagement

The recommendation is to develop systematic processes to engage with different R&I communities that could have an interest in establishing, using or re-defining STI agreements with specific partner countries. Moreover, it is important to invest in the relationship with STI agreement counterparts in the international partner country and to maintain regular communication even if the current collaborative activities are not active.

Addressee: National ministries responsible for signing intergovernmental STI agreements or MoUs, as well as regional entities and agencies which conclude international STI agreements or MoUs.

4.5 Emergence of 'good' cooperation principles in international R&I cooperation

The MLE clearly showed that new value-based principles and requirements in international R&I cooperation are emerging (Könnölä, 2019). This development is being strengthened by the increasing attention directed towards challenge-driven R&I and the enhanced inclusion of economic objectives in international R&I cooperation policies (see sections 4.1. and 3.1). How far the Market Objective as well as the Grand Challenge Objective are being directly converted into more specific cooperation requirements imposed on international R&I cooperation, however, is not yet clear.

For the selection of partner countries, for instance, issues such as access to public procurement of innovative solutions in the international partner country, or issues concerning clear agreements on standardisation and its enforcement, are only mentioned by some MLE participants. Rules relating to Intellectual Property Rights (IPR) and their enforcement, however, are already perceived as more important and thus also more applied as criteria for the selection of international partner countries. Naturally, more elaborated market-driven considerations in the selection of international partners are addressed in more detail by close-to-market funding organisations, such as Business Finland, while their relevance for agencies cooperating in the realm of fundamental science is considered to be less important.

The refusal of military purpose and dual-use in international R&I cooperation is, by contrast, a shared and widely applied concern in the selection of partner countries or agencies. Reciprocity in funding also has some importance, especially vis-à-vis developed countries. The opportunity to access scientific infrastructure in international partner countries is also already applied by some

MLE participants as a criterion for the selection of a partner country. At the level of intergovernmental science and technology agreements (STA), however, the notion of ethical research practices is not widely applied as a requirement in international partner country selection, probably because it is presupposed.

In some STAs and MoUs, a reference to the respective applicable national law or regulations of each signatory country is made. There are seldom references to international standards. Mechanisms for inspection and enforcement are, however, usually not made explicit. The programme owners rely on feedback from the research communities, but dedicated points of contact for complaints or ombudsman are rarely established.

In the new MoUs of the Ministry of Education and Culture of Finland, for instance, the following paragraph has been included:

Both participants accept that this MoU is based on mutual respect for core higher education and research values, including equitable access, public accountability, academic freedom, institutional autonomy and social responsibility, as articulated in the 1997 UNESCO Recommendation concerning the Status of Higher-Education Teaching Personnel and subsequent instruments.

With regard to the implementation of 'good principles' in R&I activities with international partner countries, the MLE participants consider issues of securing excellent research (such as competitive and peer-review based processes), research ethics and research integrity as being most relevant. During implementation, the awareness of other aspects – such as dual-use research, gender equality, open access (to publications and data) or access to copyright-free or open-licensed software – varied considerably among the respondents to the third survey (Könnölä, 2019). The consideration of 'good principles' during implementation depends mostly on the funding organisations.

In case of non-acceptance or non-enforcement of a 'good principle' by a partner country, there was widespread agreement among the MLE participants that pressure on a partner country is not helpful. To overcome the problem, a soft way of exerting influence, by promoting the good principle under scrutiny through examples and showing its added value, is regarded as the preferred (and only feasible) solution. Sometimes the partners also have different understandings about some 'good principles'. In such cases, it is advantageous to enter into dialogue with the partner to clarify the perspectives and understandings (see also Recommendation 10). This has proven to be successful in some cases.

The European level is widely perceived as a global driver for setting standards in international R&I cooperation. Non-EU countries are approaching the European Commission to learn from its experience (e.g. how to deal with IPR, data protection, research integrity, open science, etc.). The association of third countries to the European Union's Framework Programme for R&I is considered to be the 'hardest' trigger for the adoption of good principles.

MLE participants mentioned that the widespread adoption of 'good principles' across several research communities within the EU was also supported by the European Commission through several soft measures, especially in the Science with and for Society (SwafS) programme, but also at governance level through Mutual Learning Exercises implemented under the H2020 Policy Support Facility. Such supporting coordination actions, however, are lacking at the international outreach level. Another argument raised was that the Horizon 2020 National Contact Points (NCPs), both in and beyond the EU Member States, should be better trained and informed about 'good principles'. Outside the EU, in particular, NCPs often have only limited knowledge and understanding about the importance of 'good principles' in joint research undertakings financed by the European Commission.

The MLE participants consider it helpful to develop 'good principles' together with the European Commission so that European standards are also reflected, step by step, in international R&I cooperation initiatives driven by the Member States. Some participants argued that the processes of dissemination and acceptance of 'good principles' across the different partner countries and regions should be supported by the European Commission. A common European approach and a common way to deal with infringements of 'good practices' would also facilitate harmonisation between the European Commission and the Member States.

In order not to re-invent the wheel, it is important to reflect and take up already existing efforts, for instance of Science Europe (2016) and SFIC (2015), as well as existing standards and recommendations such as the revised 'European Code of Conduct for Research Integrity' (ALLEA, 2017), the 'STINT Guidelines for Responsible Internationalisation' (Shih et al., 2020) or the 'Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations' (2013).

Another new development is the increasing awareness about the relevance of issues of societal impact, multidisciplinarity, and cross-industry connections in calls launched for international R&I cooperation (in descending order of importance, according to the respondents to the third survey). These partially interconnected and self-enforcing aspects also challenge the design of programmes or the access to suitable reviewers. The process of opening up towards civil society organisations, consumer/client organisations and policy-makers from the non-R&I sphere in the scoping and implementation of programmes can also become more frequent in the future. Experiments at the national level are being carried out to find out how inter- and trans-disciplinary calls can be set up to create incentives for broad participation and achievement of intended results, but this is, as yet, rarely the case in the field of international R&I cooperation beyond the European level.

Recommendation 11: Establish joint action on 'good principles' in international R&I cooperation

Based on the existing work of SFIC, Science Europe, ALLEA and others, the recommendation is to establish a joint action on 'good principles' for the level of ministerial or intergovernmental STAs and MoUs operationalised through a European consortium, involving experts, agencies and ministries responsible for international R&I cooperation, *whose task is*:

- *to map the existing practices of international partner countries, EU Member States and countries associated to the European Union's Framework Programme for R&I, as well as agencies and relevant science fora, in terms of the application of 'good principles';*
- *to consult with ministries responsible for R&I at Member State level on priorities, cases of application and feasibility;*
- *to empirically analyse and reflect on the situation with stakeholders, as they often have long-standing practical experience;*
- *to draft a* vademecum *and a code of conduct on the use of 'good principles' in international R&I cooperation;*
- *to promote the code of conduct in Europe and beyond Europe through international outreach and dissemination measures.*

Addressee: National ministries responsible for signing intergovernmental STI agreements or MoUs, probably coordinated through SFIC.

4.6 Anticipating the future to remain agile

The time horizon of both national and international R&I strategies is often around 10 years. Given the diversity and speed of developments experienced in the last 10 years, this duration might seem quite long because change processes can gain considerable momentum. Accelerated and targeted technical developments, global exchange of information or the ever-faster growing knowledge base are not just changing modern societies technologically. They also drive forward socio-technically interlinked iterative dynamics that shape everyday life as well as social structures, institutions and their actors.

In view of the considerable progress made in fields such as artificial intelligence (AI), autonomous robotics, nano- and quantum technology, gene-editing and synthetic biology (Zweck, 2018) – as well as accelerated global challenges in the field of climate change, the preservation of biodiversity, dwindling natural resources, demographic and migration challenges, challenged systems of world trade and global economy, civic and religious crises, political and increasingly military uncertainties – this dynamic is unlikely to diminish. Moreover, there are also new forms of R&I organisation that result in largely decentralised research landscapes that are global and open to research-driven organisations and individuals but often unknown to governments (Leitner, 2018).

Within the UN framework, foresight has been deployed in particular by UNCTAD's Commission on Science and Technology for Development (CSTD), UNDP's Innovation Facilities and UNESCO's Futures Literacy Laboratories (FLL) which is part of the Management of Social Transformations (MOST) Programme[16] (IATT, 2018). Outside the UN system, the European Commission and the OECD have advanced foresight practices across different sectors and themes (for more information, see Könnölä, 2019).

The International Institute for Applied Systems Analysis (IIASA), the Sustainable Development Solutions Network (SDSN) and the Stockholm Resilience Centre (SRC) have also launched 'The World in 2050' (IIASA, 2019), a global research initiative bringing together a network of leading policy-makers, analysts, modelling and analytical teams and organisations from around the world to collaborate in developing pathways towards sustainable futures and policy frameworks needed for implementing the SDGs and, more importantly, for achieving the needed transformational change. Future Earth (FutureEarth, 2019) can also be mentioned as an international example (for more information, see Könnölä, 2019).

Stahl-Rolf and Noetzel (2018) argue that international R&I cooperation policy-making could especially benefit from foresight – especially roadmapping that serves the mid-term perspective in particular, not least by identifying important partner countries and topics – and by pursuing long-term goals together. Könnölä and Haegeman (2012) also consider the role of foresight as an integrator of international R&I programming functions, structuring the engagement of stakeholders from different countries, sectors and disciplines and facilitating and speeding up the implementation.

The MLE participants share the conviction that it is important to learn from past experiences but also that a strategy and a roadmap for international R&I cooperation must remain agile to respond to new challenges resulting from upcoming developments and anticipated futures. To prepare for the future, the MLE participants consider that joint EU efforts that are relevant in tackling frontier technologies (e.g. artificial intelligence, quantum technology) would be needed.

Some MLE participants already use foresight and roadmapping approaches to develop national R&I strategies and/or to prepare for international cooperation. Foresight exercises, are, however, rarely applied at national level for the purpose of preparing the knowledge base for the development of R&I internationalisation strategies. Slightly less than half of the countries participating in this MLE have organised 'future anticipation' in the field of international R&I policy-making in the past. This has been done partly in cooperation, within the framework of international-oriented ERA-NET (Brummer et al., 2008) and INCO-NET projects funded under FP7 by the European Commission (e.g. with Russia [Spiesberger et al., 2011]; India [Blasy and Degelsegger 2012]; Southeast Asia [Degelsegger et al., 2011]; and Latin America [Degelsegger-Márquez et al., 2017]).

[16] http://www.unesco.org/new/en/social-and-human-sciences/themes/most-programme/

During the MLE Workshop in Paris, the discussions about fields of foresight application focused on three domains (see Schuch, 2019 for further information):

- Geopolitics and STI policy-related framework changes
- The global biosphere challenge to secure a planet worth living on
- The global social needs challenge to sustain or improve quality of life.

Several ideas for joint activities were identified. However, the views varied considerably on the implementation of participatory foresight processes on challenge-driven societal transformation (Schuch, 2019). It appears also that some have not formed their opinion yet.

The translation of global challenges into adequate programmatic and instrumental R&I internationalisation policies is challenging. The geopolitical changes, and the bio- and social challenges, which are interconnected, are now of such magnitude that no single country can tackle them entirely on its own. A complex alignment among countries, sectors, stakeholders and disciplines is required, but existing approaches are, as yet, far from optimal. New approaches, and probably also new structures and governance mechanisms, have to be developed. Foresight, including roadmapping and other methodologies to look into the future, can contribute to forward-looking strategic planning and to the development of joint approaches.

Recommendation 12: Integrate foresight in national funding practices and develop international joint foresight activities for R&I cooperation

At the national level, ministries and funding organisations should further explore how to benefit from integrating foresight in their practices. Thus, the recommendation is to conduct, at the international level, a study to learn from experiences about the use of foresight for international R&I programming. Different combinations of Member States and Associated Countries could also start joint foresight initiatives to reduce costs and enhance relevance, quality and effectiveness, benefitting also challenge-driven and transformative international R&I cooperation.

Addressee: Groups of Member States and countries associated with the European Union's Framework Programme for R&I and/or groups of funding agencies or councils for R&I on variable geometry, perhaps coordinated by SFIC.

4.7 An enhanced role of SFIC?

During the MLE, SFIC was often mentioned as the most important platform for the coordination of international R&I cooperation among the Member States and the countries associated to the Framework Programme, and that its role and functionality must be further developed, especially in view of its limited resources and complex governance.

SFIC was also called on, several times, to empower its role as the only remaining body at the cross-Member State level to deal with international R&I cooperation (as there are no programme committees anymore and no INCO NCPs).

Particular tasks that could potentially be addressed and coordinated by an enhanced functionality of SFIC are frequently mentioned throughout this report. They refer, among others, to:

- Reducing information asymmetries in R&I cooperation with particular international partner countries (see Section 3.2)
- Better coordinating joint R&I internationalisation policies of MS/AC with the European Commission (see Section 3.5)
- Launching a working group on standards in the evaluation and monitoring of international R&I cooperation (see Section 3.6)
- Piloting multilateral R&I internationalisation activities agreed between variable geometries of MS/AS (see Section 4.1)
- Establishing multi-stakeholder partnerships for challenge-driven international R&I activities (see Section 4.2)
- Exploring the role that SFIC could play in launching multilateral STI agreements (see Section 4.4)
- Sharing good foresight practices and initiating joint foresight activities (see Section 4.6)
- Facilitating an interface to invite certain international partner countries to work on joint issues adopted by European Member States
- Becoming a more effective consultation partner for the sake of international R&I cooperation in general.

Firstly, therefore, it is important to discuss, identify and prioritise approaches and activities where the role and support of SFIC can add value to joint multilateral agenda setting and corresponding operational activities.

Secondly, a solution has to be identified as to how SFIC can increase its operational effectiveness. Expectation management has to be clearly addressed by considering the available capacities. Creative thinking about how to supply SFIC with adequate additional resources (and/or capabilities) while not contradicting Council legislation may also be needed. Operational support for SFIC might be conceived through different formats but it should in any case secure access to and use of expert resources via its chair.

Recommendation 13: Empower SFIC to play a more active role in the coordination of joint R&I internationalisation activities

The recommendation is to increase the operational capability of SFIC (or any succeeding body for cross-MS/AC coordination on international cooperation in STI) to perform its coordinating role in joint multilateral R&I cooperation activities between EU Member States/Associated Countries and selected international partner countries or regions on the basis of variable geometry.

Addressee: The Council of the European Union, SFIC and national ministries responsible for international R&I cooperation from the Member States and countries associated to the European Union's Framework Programme for Research and Innovation.

5 Literature

Alkemade, F., Heimeriks, G., Schoen, A., Villard, L. and Laurens, P. (2015): Tracking the internationalization of multinational corporate inventive activity: national and sectoral characteristics. *Research Policy* **44**(9): 1763-72.

ALLEA (2017): The European Code of Conduct for Research Integrity. Revised Edition, All European Academies, Berlin 2017. https://www.scienceeurope.org/news/launch-of-the-revised-code-of-conduct-for-research-integrity/

Archibugi, D. and Iammarino, S. (1999): The policy implications of the globalisation of innovation, Research Policy 28(2-3), 317-36.

Athukorala, P.-C. and Kohpaiboon, A. (2010): Globalization of R&D by US-based multinational enterprises, Research Policy, 39(10), 1335-347.

Austrian Federal Ministry of Science; Austrian Federal Ministry of Transport, Technology and Innovation; Austrian Federal Ministry of Economy (2013): Beyond Europe.

AWT (2014): Boven het maaiveld. Focus op wetenschappelijke zwaartepunten. Den Haag. AWT.

AWTI (2017): STI Diplomacy. Advancing the internationalisation of science, technology and innovation. The Hague. AWTI.

Birkinshaw, J.M. and Hood, N. (1998): Multinational subsidiary evolution: capability and charter change in foreign-owned subsidiary companies', Academy of Management Review 23(4), 773-95.

Birkinshaw, J.M., Hood, N. and Jonsson, S. (1998): Building firm-specific advantages in multinational corporations: the role of subsidiary initiative, Strategic Management Journal 19(3), 221-41.

Blasy, C. and Degelsegger, A. (2012): Mediating different stakeholder levels in an 'International Cooperation Foresight' process. European Foresight Platform (EFP), Brief No. 250. http://www.foresight-platform.eu/wp-content/ uploads/2013/02/EPF-Brief-No-250_New-Indigo- Foresight-20121.pdf

Blonigen, B.A. and Slaughter, M.J. (2001): Foreign-affiliate activity and US skill upgrading, Review of Economics and Statistics 83(2), 362-76.

Boekholt, P. (2019): Tools for International Cooperation: STI Agreements. 2nd Thematic Report from the Mutual Learning Exercise on National Strategies and Roadmaps for International Cooperation in R&I. https://rio.jrc.ec.europa.eu/en/policy-support-facility/mle-national-strategies-and-roadmaps-international-cooperation-research-and

Boekholt, P., Edler, J., Cunningham, P. and Flanagan, K. (2009): Drivers of International collaboration in research. Report for the European commission, DG Research, Brussels.

Brandenburg, U. and Federkeil, G. (2007): How to measure internationality and internationalisation of higher education institutions! Indicators and key figures. CHE Arbeitspapier Nr. 83, Gütersloh: CHE Centrum für Hochschulenticklung gGmbH.

Brummer, V., Könnölä, T. and Salo, A. (2008): Foresight within ERA-NETs: Experiences from the preparation of an international research program. Technological Forecasting & Social Change 75 (2008), 483-495.

CREST Working Group (2007), Internationalisation of R&D – facing the challenge of globalisation: approaches to a proactive International policy in S&T, Brussles: CREST.

Dachs, B. (2017): Internationalisation of R&D: A Review of Drivers, Impacts, and new Lines of Research. AIT. https://mpra.ub.uni-muenchen.de/83367

De Backer, K., Menon, C., Desnoyers-James, I. and Moussiegt, L. (2016): Reshoring: Myth or Reality? Paris: OECD Publishing.

Degelsegger-Márquez, A., Flink, T. and Rungius, C. (2019): What it takes to do science diplomacy. Practices, identities, needs and challenges of science diplomacy practitioners. Baseline analysis and needs assessment, Deliverable 2.3, Vienna: S4D4C. https://www.s4d4c.eu/what-it-takes-to-do-science-diplomacy-practices-identities-needs-and-challenges-of-science-diplomacy-practitioners-baseline-analysis-and-needs-assessment/

Degelsegger-Márquez, A., Wagner, I., Kroop, S., Rigby, J., Cox, D., Hinze, S., Donner, P. and Adams, J. (2017): Portfolio Evaluation. FWF International Programmes. Final Report. September 2017.

Degelsegger, A., Gruber, F. and Wagner, I. (2011): Towards Professionalising ‚International S&T Cooperation Foresight': Epistemological and Methodological Challenges and How to Overcome Them. European Foresight Platform (EFP) Brief No. 201. http://www.foresight-platform.eu/wp-content/ uploads/2011/11/EFP-Brief-No.-201_SEA-EU-Net- Foresight.pdf

Deuten, J. (2015): R&D goes global. Den Haag: Rathenau Institut.

Edler, J. and Flanagan, K. (2011): Indicator needs for the internationalisation of science policies. *Research Evaluation*, Volume 20, Issue 1, March 2011, Pages 7–17, https://doi.org/10.3152/095820211X12941371876148

Ekholm, K. and Midelfart, K.H. (2004): Determinants of FDI: the evidence, in: G. Barba Navaretti and A.J. Venables (eds) Multinational firms in the world economy, Princeton and Oxford: Princeton University Press, pp. 127-50.

ERAWATCH (2013): Overview of International Science, Technology and Innovation cooperation between Member States and countries outside the EU and the development of a future monitoring mechanism. Final Report, January, 2013.

EUROHORCS (2009): Creating the ERA 'bottom-up'. Cross-border Research Cooperation in Europe – Contributions form National Research Organisations.

European Commission (2019a): The European Green Deal. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels: 11.12.2019 (COM 2019, 640 final).

European Commission (2019b): The European Green Deal. Annex to the Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. Brussels: 11.12.2019 (COM 2019, 640 final).

European Commission (2012): Enhancing and focusing EU international cooperation in research and innovation: a strategic approach. Luxembourg: Publications Office of the European Union.

European Commission (2008): INCO-NET projects. Research*eu.

European Environment Agency (2016) Sustainability transitions: Now for the long term. Copenhagen. doi: 10.2800/096291.

Fikkers, D. J. and Horvat, M. (2014): Basic Principles for effective International Science, Technology and Innovation Agreements. Luxembourg: Publications Office of the European Union.

FutureEarth (2019) Home | FutureEarth. Available at: https://futureearth.org/ (Accessed: 15 October 2019).

Gluckman, P. D., Turekian, V. C., Grimes, R. W. and Kishi, T. (2017): Science Diplomacy: A Pragmatic Perspective from the Inside, in: Science & Diplomacy 6(4).

Gnamus, A. (2009): Comparative Report on S&T Cooperation of the ERA Countries with Brazil, India and Russia. JRC Scientific and Technical Reports.

Gustafsson, G. (2019) 'Notes from the MLE meeting on the Framework Conditions for Challenge-driven International R&I Cooperation, November 12-13, 2019'. Stockholm.

Hall, B. A. (2010), *The internationalization of R&D*, Berkeley: University of California.
http://elsa.berkeley.edu/users/bhhall/papers/BHH10_RND_international_August.pdf

Hatzichronoglou, T. (2008), The Location of investment of multinationals linked to innovation, Paris: OECD.

IIASA (2019) The World in 2050 - The World in 2050 - IIASA. Available at: http://www.iiasa.ac.at/web/home/research/twi/TWI2050.html (Accessed: 15 October 2019).

IATT (2018) 'Science, Technology and Innovation for SDGs Roadmaps', (June), p. 57. Available at: https://sustainabledevelopment.un.org/content/documents/19009STI_Roadmap_Background_Paper_pre_STI_Forum_Final_Draft.pdf.

ITB (2017): Strategie zur Internationalisierung von Wissenschaft und Innovation. ITB infoservice, im Auftrag des Bundesministerium für Bildung und Forschung. 11. Schwerpunktausgabe 02/17, 16. Februar 2017.

Jensen, N.M. (2006): Nation-states and the multinational corporation, Princeton and Oxford: Princeton University Press.

Könnölä, T. (2019): Framework Conditions for Challenge-driven International R&I Cooperation. 3rd Thematic Report from the Mutual Learning Exercise on National Strategies and Roadmaps for International Cooperation in R&I. https://rio.jrc.ec.europa.eu/en/policy-support-facility/mle-national-strategies-and-roadmaps-international-cooperation-research-and

Könnölä, T. and Haegeman, K. (2012): Embedding foresight in transnational research programming. Sci. Public Policy 39, 191–207. https://doi.org/10.1093/scipol/scs020

Kuhlmann, S. and Rip, A. (2018) 'Next-generation innovation policy and Grand Challenges', Science and Public Policy, 45(4), pp. 448–454. doi: 10.1093/SCIPOL/SCY011.

Laurens, P., C. Le Bas, A. Schoen, L. Villard, and P. Larédo. (2015), 'The rate and motives of the internationalisation of large firm R&D (1994–2005): Towards a turning point? ' *Research Policy* 44(3): 765-76.

Leitner, K.-H. (2018): Foresight zur Zukunft der Kooperation in Forschung und Innovation. In ITB 12/18: Foresight und Roadmapping: Zukunft strategisch gestalten, pp 59-61.

Mayer, K. and Schuch, K. (2019). Fostering the Sustainable Development Goals in Horizon Europe. Report prepared for the Austrian Federal Ministry of Education, Science and Research (June 2019).

Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations. 3rd World Conference on Research Integrity, 5-8 May 2013 https://wcrif.org/guidance/montreal-statement

OECD (2016a) Attracting international S&T investments by firms, in: OECD (Ed.), *OECD Science, Technology and Innovation Outlook 2016*. OECD, Paris.

OECD (2010), Measuring Globalisation: OECD Economic Globalisation Indicators 2010, Paris: OECD.

OECD (2008a), The Internationalisation of business R&D: evidence, impacts and implications, Paris: OECD.

OECD (2008b), Open Innovation in Global Networks, Paris: OECD.

OECD (2008c), Recent trends in the internationalisation of R&D in the enterprise sector, Paris: DSTI/EAS/IND/SWP (2006)1/Final.

OECD (2005), Measuring globalisation: OECD economic globalisation indicators, Paris: OECD.

RCN (2010): Strategy for International Cooperation 2010-2020. Norwegian Research Council, 18 November 2010.

Royal Society and AAS (2010): New frontiers in science diplomacy. Navigating the changing balance of power. London: 2010.

Rungius, C., Flink, T. and Degelsegger-Márquez, A. (2018): State of the Art Report: Summarizing literature on science diplomacy cases and concepts, S4D4C Deliverable 2.2. online: https://www.s4d4c.eu/wpcontent/uploads/2018/08/S4D4C_State-of-the-Art_Report_DZHW.pdf.

Science Europe (2016): Research Integrity Practices in Science Europe Member Organisations. July 2016. https://oeawi.at/downloads/?cat=38

Schot, J. et al. (2018): Addressing SDGs through Transformative Innovation Policy, p. 8. Available at: www.tipconsortium.net.

Schuch, K. (2019): National Strategies and roadmaps for international cooperation in R&I. 1st Thematic Report from the Mutual Learning Exercise on National Strategies and Roadmaps for International Cooperation in R&I. https://rio.jrc.ec.europa.eu/en/policy-support-facility/mle-national-strategies-and-roadmaps-international-cooperation-research-and

Schuch, K. (2017): Techno-Globalization and Innovation. In*: Springer Encyclopaedia on Creativity, Invention, Innovation, and Entrepreneurship*, doi:10.1007/978-1-4614-6616-1_336-2

Schuch, K. (2011): Indikatoren zur Messung der Internationalisierung von Wissenschaft und Forschung. Im Auftrag des BMWF. Wien: Zentrum für Soziale Innovation.

Schuch, K. (2008): Bestandsaufnahme und Positionierung der international ausgerichteten FTE- Programme Österreichs. Austrian Council/ZSI, Vienna.

Schwaag Serger, S. and Remoe, S. (eds.) (2012): Report of the Expert Group established to support the further development of an EU international STI

cooperation strategy. Luxembourg: Publications Office of the European Union, 2012.

Schwaag Serger, S. and E. Wise (2010), *Internationalization of Research and Innovation – new policy developments*, Seville: paper presented at the 2010 Concord Conferen

SFIC (2019): Final report of the SFIC Benchmarking Working Group on the Benchmarking exercise on strategies and roadmaps for international cooperation in R&I. EUROPEAN RESEARCH AREA AND INNOVATION COMMITTEE Strategic Forum for International S&T Cooperation. ERAC-SFIC 1359/19. December 2019.

SFIC (2018): Overview of Tools for International Research Cooperation in Science and Technology Matters. EUROPEAN RESEARCH AREA AND INNOVATION COMMITTEE Strategic Forum for International S&T Cooperation. ERAC-SFIC 1358/18. December 2018.

SFIC (2015): SFIC opinion on Common principles for the conduct of international R&I cooperation. EUROPEAN RESEARCH AREA AND INNOVATION COMMITTEE Strategic Forum for International S&T Cooperation. ERAC-SFIC 1357/15; 18. Juni 2015.

Shapira, P., J. Edler, D. Gagliardi, A. Verbeek, E. Lykogianni, and M. Knell (2009), *Analysis of R&D international funding flows and their impact on the research system in selected Member States*, Brussels: RINDICATE specific assignment 7.

Shih, T., Gaunt, A. and Östlund, S. (2020): Responsible internationalisation: Guidelines for reflection on international academic collaboration. Stockholm: STINT, 2020.

Sigl. L. and Witjes, N. (2014): Koordinations- und Kooperationsstrukturen für die Internationalisierung österreichischer Forschung, Wissenschaft und Technologie (EU-Drittstaaten). Zukunftsräume der internationalen FTI-Kooperation. Studie im Auftrag des Rats für Forschung und Technologieentwicklung. Oiip, Wien, 2014.

Spiesberger, M. und Degelsegger-Márquez (2018): Foresight für international Wissenschaftspolitik. In ITB 12/18: Foresight und Roadmapping: Zukunft strategisch gestalten, pp 62-64.

Spiesberger, M., Schuch, K., Carabias-Barcelo, V., Haegeman, K., and Sokolov, A. (2011): Foresight for EU-Russia S&T and innovation cooperation. EFP Brief No. 189. http://www.foresight-platform.eu/brief/efp-brief-no-189-foresight-for-eu-russia-rd-and-innovation-cooperation/

Stahl-Rolf, S. and Noetzel, R. (2018): Foresight und Roadmapping – Zukunft strategisch gestalten. In ITB 12/18: Foresight und Roadmapping: Zukunft strategisch gestalten, pp 5-8.

TAFTIE (2009), Internationalisation of National Innovation Agencies, Stockholm: TAFTIE.

Technopolis Group (2016): R&D attraction networks – A report on stakeholder cooperation and STI diplomacy to attract investments in R&D. The Hague on behalf of AWTI.

UNCTAD (2005), World Investment Report 2005: Transnational Corporations and the Internationalization of R&D, New York and Geneva: United Nations.

United Nations (2015) 'Transforming our world: the 2030 Agenda for Sustainable Development'. New York: United Nations, p. 35

Vullings, W., Boekholt, P., van Til, J., Steinz, H., Cunningham, P., and Flanagan, K. (2013): Overview of international science, technology and innovation cooperation between Member States and countries outside the EU and the development of a future monitoring mechanism. Luxembourg: Publications Office of the European Union.

Zweck, A. (2018): Zukunftsforschung – Zukünftige Herausforderungen für eine noch nicht fertige Disziplin. In ITB 12/18: Foresight und Roadmapping: Zukunft strategisch gestalten, pp 9-12.

ANNEX 1: EXECUTIVE SUMMARY THEMATIC REPORT NO.1: FRAMEWORK CONDITIONS FOR CHALLENGE-DRIVEN INTERNATIONAL R&I COOPERATION

The Thematic Report No 1 discusses the main policy challenges and practices regarding the design and development of national strategies for international research and innovation (R&I) cooperation. This report builds on a literature review, the discussions during an MLE meeting in Paris on 3 and 4 June 2019 and the first survey to the MLE participants.

The report focuses on R&I internationalisation policies and not on R&I internationalisation in general. It deals with:

- The globalisation of R&D
- Objectives of R&I internationalisation and underlying theories of change
- The selection of partner countries and thematic priorities
- The challenge of embedding R&I internationalisation policies in overall national and European R&I strategies
- Governance coordination and processes for the development of an R&I internationalisation strategy or roadmap
- Futures thinking – scenarios for international R&I cooperation
- Assessing progress – indicators, benchmarking and monitoring.

Most countries have an R&I internationalisation strategy or roadmap which focuses both on countries inside and outside Europe. The most frequently mentioned **objectives** include excellence in research, science diplomacy, development of the European Research Area, global challenges and innovation. The notion of innovation is becoming more and more important, but to combine academic knowledge production and business-driven innovation in international R&I cooperation remains a challenge. Although increasingly emphasised as a priority, the goals of science diplomacy remain vague.

The **broadening of the scope** of national strategies and roadmaps for international cooperation in R&I usually goes along with increased involvement of stakeholders from different branches of government as well as from funding agencies, academia and business. It also calls for more **coordination efforts,** especially during implementation processes. Stakeholder engagement in partner countries is considered to be the responsibility of the partner country.

Countries prioritise cooperation with top R&I performers and a few emerging economies, usually those with large domestic markets. The **selection of**

partner countries is usually based on a combination of political considerations, evidence-based analysis as well as initiatives emerging from individual or institutional networks within research and innovation communities.

MLE participants also promote international R&I cooperation by using **European structures, programmes and instruments**, but they call for more explicit European coordination and support measures to enhance multilateral R&I cooperation between the Member States and international partner countries.

Monitoring and evaluation of progress during the implementation of international cooperation in R&I is of crucial importance but the availability of experience is limited. The use of foresight for international R&I cooperation is also limited.

ANNEX 2: EXECUTIVE SUMMARY - THEMATIC REPORT NO 2: TOOLS FOR INTERNATIONAL COLLABORATION: STI AGREEMENTS

Thematic Report No 2 discusses the experiences with Science, Technology and Innovation (STI) agreements used by European Member States (MS) and Associated Countries (AC). The STI agreements represent a frequently used policy tool from the wider STI cooperation toolbox in European countries. The report takes stock of the experiences with Science, Technology and Innovation (STI) agreements to develop a better understanding of their critical success factors and what makes them unsuccessful. The report also reports on the views of the MLE participants on the future use of STI agreements. The 15 participating MLE countries provided information on their successful and less successful STI agreements and exchanged experiences during workshops in a second country visit (Bucharest, 16 and 17 September 2019). These policy learning processes and findings are summarised.

The three features that stand out in being reported as **critical success factors** behind the STI agreements are the following (in order of importance):

1. Mutual interests of the beneficiaries in the thematic areas of co-operation

2. The relationship and alignment between the implementing agencies

3. Political commitment (and budgets) to support the cooperation.

The main reasons why STI agreements were considered unsuccessful was when politics and high -evel policy launch the STI agreements without considering the STI policy interests; when there is a lack of implementation activities and communication platforms between the agencies on both sides; and finally when there is a lack of demand for cooperation in the STI communities to cooperate with counterparts in a particular partner country.

The MLE findings also confirmed what is already frequently reported in the STI collaboration literature that there is generally a **lack of monitoring and evaluation** of the STI agreements.

While **science diplomacy** sometimes leads to STI agreements that are not actively implemented ('sleeping beauties'), the political benefits from a foreign policy perspective were acknowledged by the MLE participants. A better coordination between high-level policy-making responsible for signing STI agreements and the STI agencies responsible for implementing them can contribute to making these agreements more effective.

While EU Member States/Associated Countries are thinking of new and more flexible ways to arrange international agreements, the signing of 'classic'

intergovernmental STI agreements is still considered politically important. There was little expectation that the portfolio of national STI agreements would be streamlined or reduced in a significant way in the future.

For the future it was envisaged that more **multilateral STI agreements** should be launched in order to address global challenges and sustainable development goals. However, in practice only a few MLE countries are experienced in running this type of multilateral agreement. For the near future this is seen as a challenge to take action on.

ANNEX 3: EXECUTIVE SUMMARY THEMATIC REPORT NO 3: FRAMEWORK CONDITIONS FOR CHALLENGE-DRIVEN INTERNATIONAL R&I COOPERATION

The Thematic Report No 3 discusses the experiences of European Member States and Associated Countries concerning framework conditions for challenge-driven international R&I cooperation. By **challenge-driven international R&I cooperation** we referred to international cooperation practices in R&I to solve shared challenges, specifically, major societal challenges or grand challenges.

This report builds on a literature review, the discussions during an MLE meeting in Stockholm on 12 and 13 November 2019 and the third survey to the MLE participants. It provides a brief introduction and reflections from MLE participants on the current state of challenge-driven international R&I cooperation and related existing framework conditions at the national, European and global level.

There is widely shared interest in developing challenge-driven policies at the level of international R&I cooperation. The most used reference framework available is the **UN Sustainable Development Goals (SDG), which may provide a common 'language' on objectives.** In practice, addressing the challenge-driven policies takes many forms among countries and organisations conditioned by their specific national frameworks.

When international R&I cooperation shifts towards challenge-driven approaches, the role of different framework conditions also changes. While previously the emphasis has been, for instance, on ethics, research integrity, and open access, attention has gradually extended and focused on science diplomacy in response to geopolitical risks and the increased importance of the SDGs among other drivers of change. Hence, international R&I collaboration can affect and drive changes in framework conditions and vice versa.

Framework conditions for challenge-driven international R&I programmes need to pay more attention as to how to extend the scoping of programmes and partner selection, the calls, the peer reviews and the programme evaluations to **incorporate interdisciplinarity, market access and societal impact considerations.** This may also mean extending the set of criteria beyond scientific excellence and being more flexible with reciprocity of funding for instance. Framework conditions change also as R&I cooperation becomes increasingly **connected horizontally to other policy fields and as private funding organisations** create a need to explore synergies and complementarities across policy fields and sectors.

Furthermore, addressing challenges may call for the introduction of changes in institutional structures which are needed to reach societal transformation. This may create expectations for institutions, including funding organisations, on the

one hand, to consider ethics or research integrity principles even more rigorously, and on the other, **to initiate processes of reflexivity and the engagement of a wide set of stakeholders**, which may be addressed via foresight and other participatory processes.

For the way forward, one key aspect is how countries can coordinate their efforts across sectoral boundaries and national frontiers to jointly overcome barriers and to scale up initiatives towards transformative R&I policies.

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This Final Report of the Mutual Learning Exercise on 'National Strategies and Roadmaps for International Cooperation in R&I' summarises findings from the workshops, discussions and thematic input papers produced during this exercise. The report reflects the main threads of an intense policy exchange on the various national approaches towards international cooperation in research and innovation and highlights identified sustained challenges and new or upcoming developments. Based on shared concerns, promising approaches and inspiring practices, conclusions are drawn, and recommendations are formulated to enhance the effectiveness of international R&I cooperation strategies, roadmaps and activities of the EU and its Member States.

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